Martin Teetor, inventor of an adding machine,
and the Teetor Adding Machine Company he headed.

Some time ago I searched for information about adding machines, and other office appliances. I found ads and articles about a Teetor adding machine, that I had never read or heard about. This lead to a search for the history of the Teetor Adding Machine Company, and of Martin Teetor, the man behind it.

Martin Teetor was born November 11 1862. He married Minnie J. Randolph April 8 1888. They had a daughter, Evelyn.

Martin Teetor was a watchmaker with the Marquard wholesale jewelry house. Repairing adding machines he became interested in their construction. He designed and built the Teetor adding and subtracting machine. The Teetor Adding Machine Company was formed December 18 1916.

Martin Teetor died of paralysis December 24 1920.

On December 24 1921 a fire destroyed the building where the Teetor Adding Machine Company was located, causing around half a million dollar in damages.
In 1922 the Teetor Adding Machine had moved to Los Angeles, and built a factory in Pomona. By March 1923 the building had been completed, and production started around August 1923. According to an article from February 5 1924, they were looking for another location. What happened after that, I was unable to find, but they had become inoperative and void by March 17 1926.

I also found Martin Teetor tied to the start of the Butler Machinery Company in Des Moines, but I do not know if it is the same man.

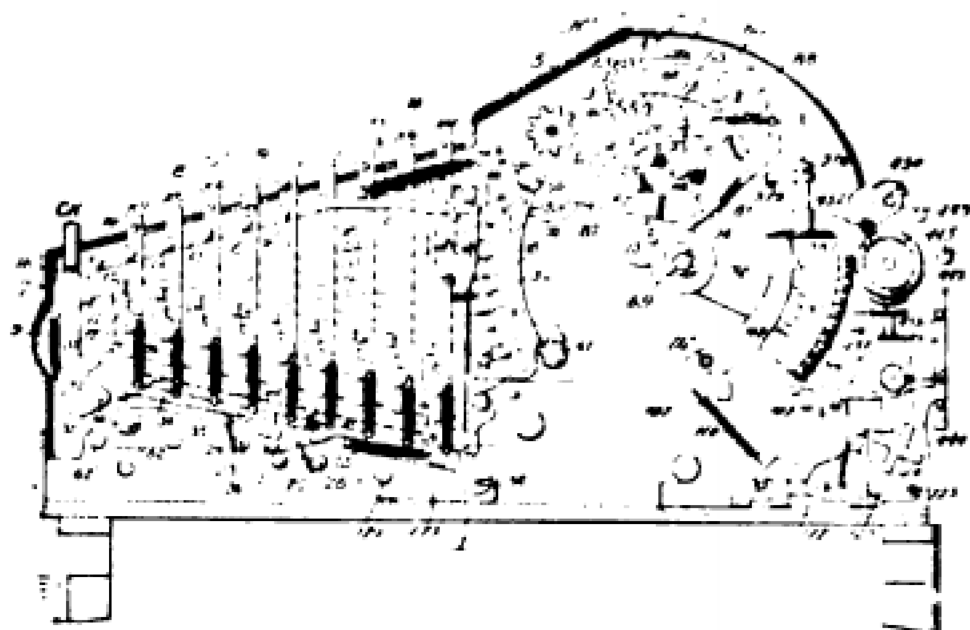
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Titlepage.png

1,167,132. ATTACHMENT FOR CALCULATING MACHINES: Martin Teetor, Des Moines, Iowa. App. filed March 3, 1911. Motor controlled by treadle.

NEXT ITEM

Moines, Iowa, a Corporation of Iowa. Filed Apr. 18, 1914, Serial No. 832,924. Renewed Nov. 24, 1919. Serial No. 340,289. 83 Claims. (Cl. 235—60.)



1. In a calculating machine, a casing, a plurality of transverse shafts mounted therein, a series of partitions removably supported on and slidably engaging said shafts, releasable means for retaining said sections in position on said shafts and adapted to be lifted away therefrom, key mechanism carried by each partition and removable therewith, and a section secured to each partition, said sections fitting together removably and forming a portion of the casing top or cover.

4. In a calculating machine, a depressible key stem carrying a lug, a swinging stop for holding said key depressed, a stop wire, and a swinging connection between said stop wire and said key stop to permit movement of said wire while said key is depressed.

22. In a device of the class described, a lever carrying type at one end, and a stop nose at the other end, a rock shaft serving as a support for said lever, a separate rack arm also supported by said rock shaft and a friction connection between said rock shaft and said lever and between said rock shaft and said rack arm.

46. In a calculating machine, swinging racks, accumulator pinions adapted to mesh with said racks, a lever and mechanism associated therewith for snapping said pinions into mesh with said racks at the beginning of the forward stroke of the latter and out of mesh at the end of the forward stroke thereof, or vice versa, according to the setting of said lever, a control lever for said swinging lever adapted to assume two positions, connections between the control lever and the lever whereby, in whichever position the control lever may be, it may move substantially to the opposite position before disturbing the setting of the swinging lever and thereafter in its continued movement will quickly snap the swinging lever to the opposite position, and means for locking the machine during the shifting of the control lever.

51. In a machine of the class described, the combination of a shifting carriage, a platen carried thereon, printing mechanism coöperating with said platen, key-set mechanism for governing the action of the printing mechanism, an adding and subtracting lever, and power-driven means for shifting said carriage with respect to said printing mechanism when said adding and subtracting lever is shifted.

NEXT ITEM

Disclaimer.

1,344,191.—*Martin Teetor*, Des Moines, Iowa. CALCULATING MACHINE. Patent dated June 22, 1920. Disclaimer filed October 31, 1927, by the assignee by mesne assignments, *Lincoln Accounting Machines Company*.

Hereby disclaims any structure falling within claims 7, 8, 12, and 25 of said patent as set forth more specifically below:

Claims 7, 8, and 12.—Your petitioner hereby disclaims any construction falling within the terms of any of these claims wherein the "adding lever" controls the release of a motor for operating the machine.

Claim 25.—Your petitioner hereby disclaims any construction falling within the terms of this claim, except one wherein the connections for preventing movement of the platen out of printing position are under the control of means for effecting clearing of the machine.

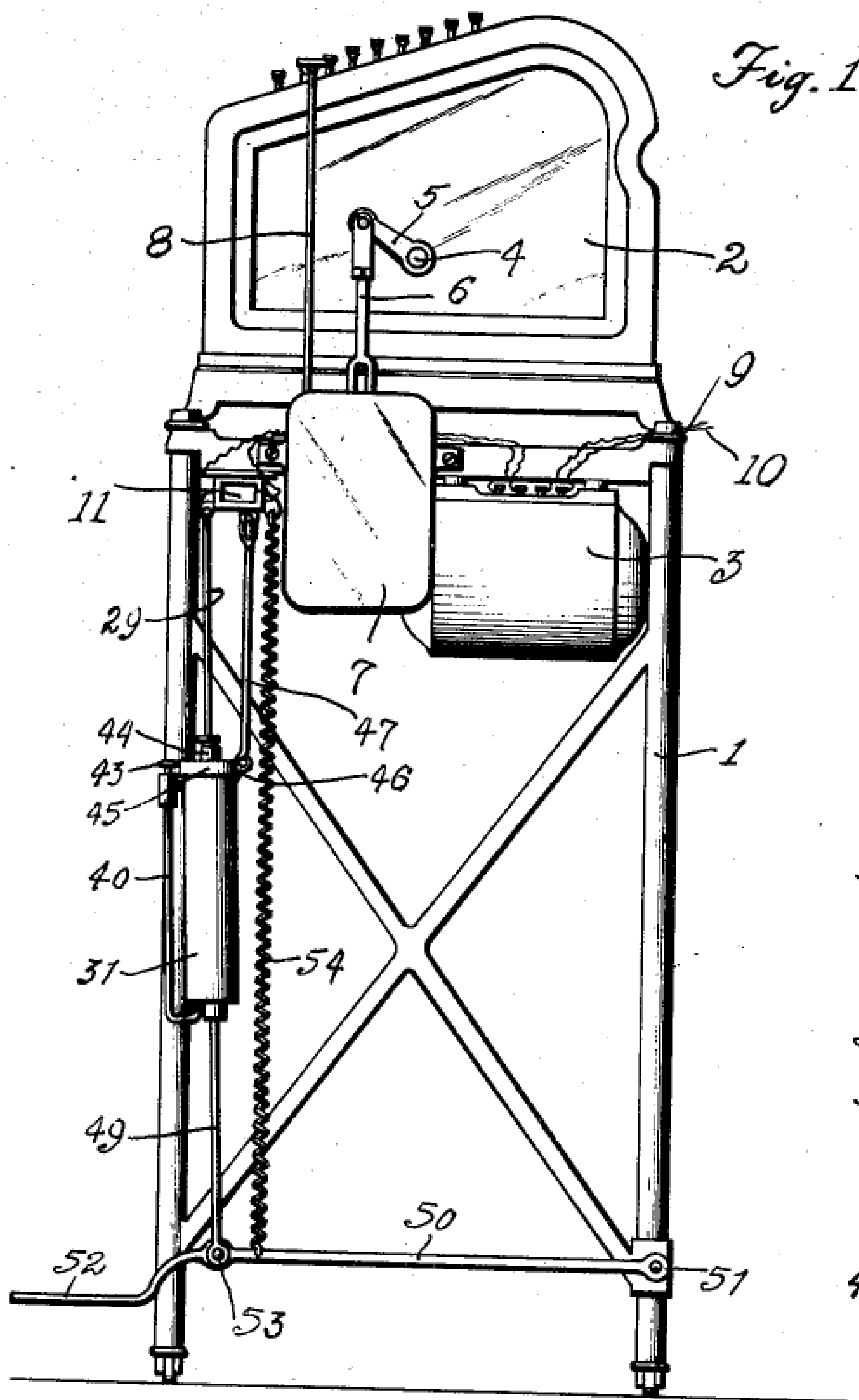
1927 11 22 - USPO v364 p780 Teetor Disclaimer.png

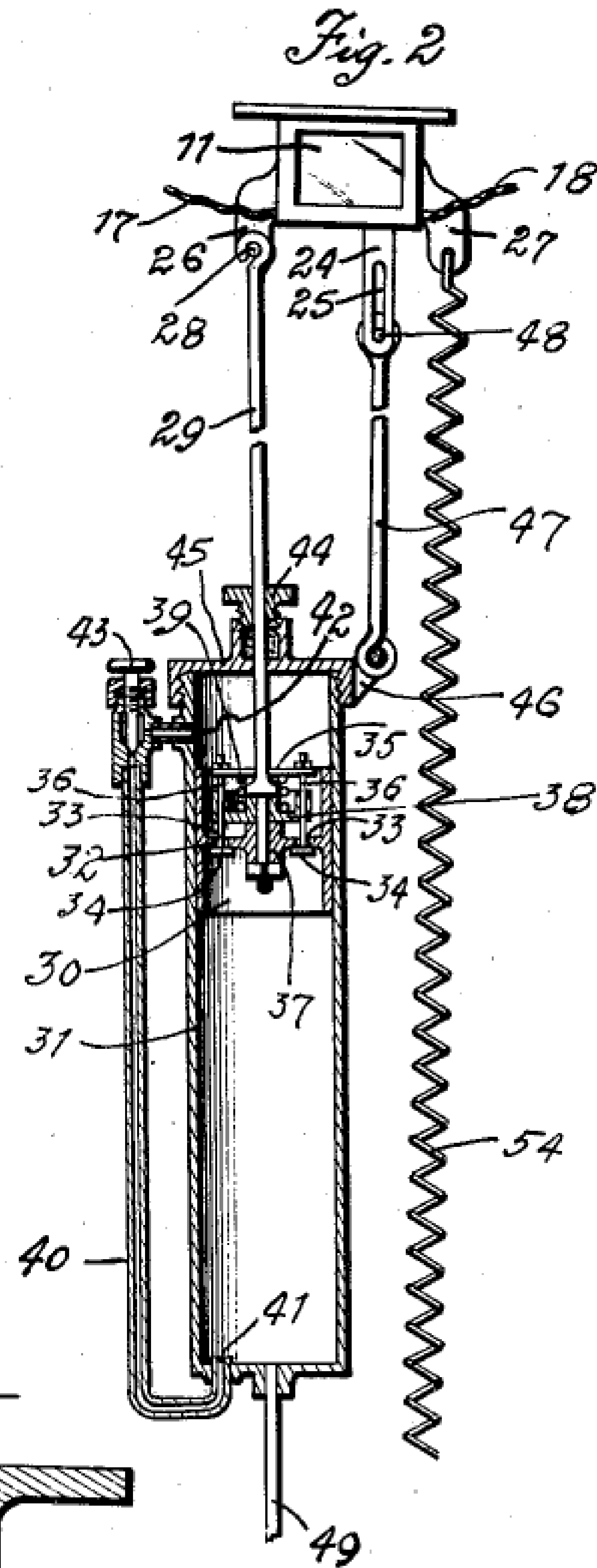
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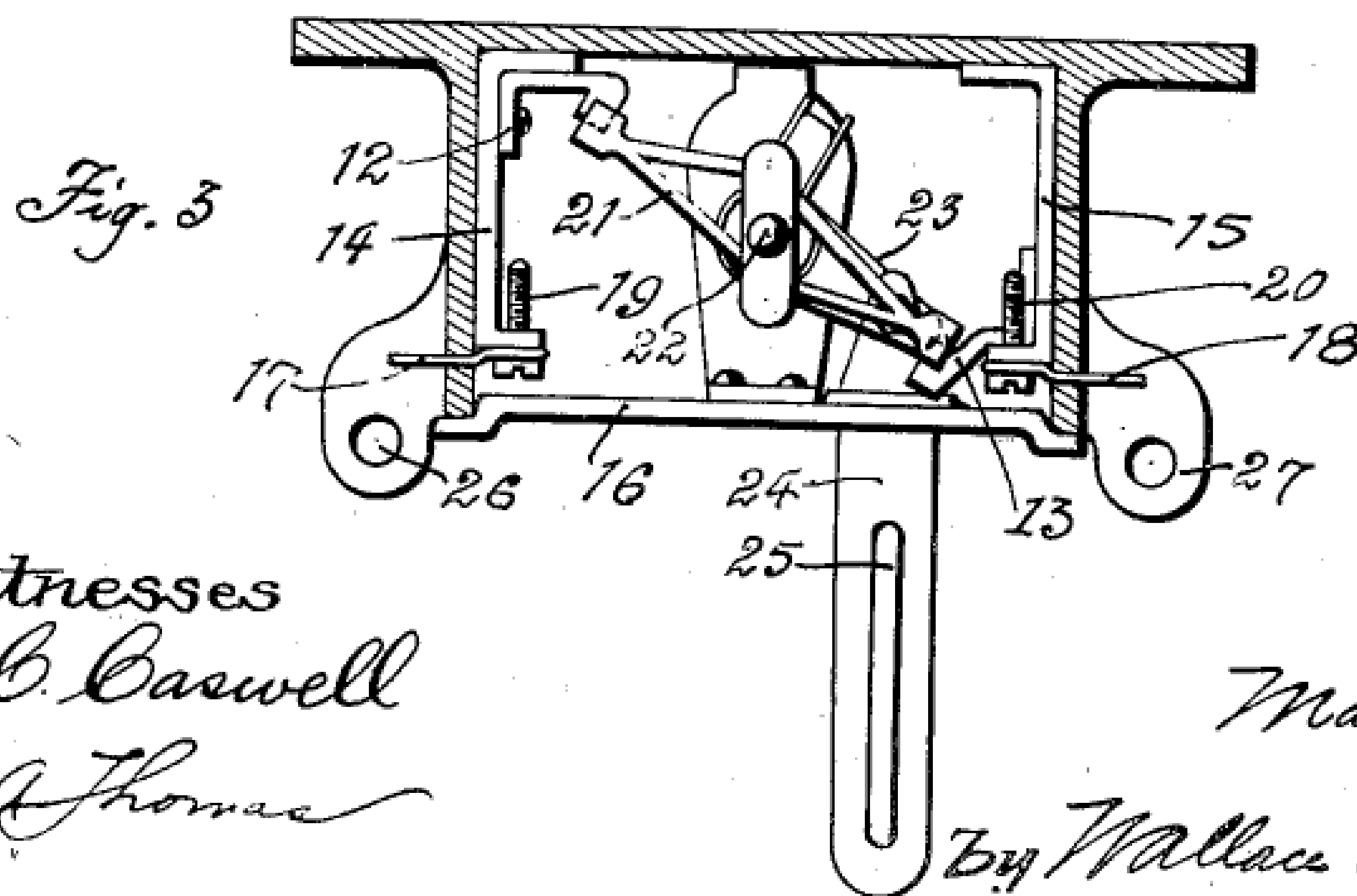
M. TEETOR.
ATTACHMENT FOR CALCULATING MACHINES.
APPLICATION FILED MAR. 3, 1911.

1,167,132.

Patented Jan. 4, 1916.







Witnesses
F. C. Caswell
A. A. Thomas

Inventor
Martin Teetor

By Wallace R. Lane Atty.

1911 03 03 US1167132 p01.png

UNITED STATES PATENT OFFICE.

MARTIN TEETOR, OF DES MOINES, IOWA, ASSIGNOR TO TEETOR COMPANY, OF DES MOINES, IOWA, A CORPORATION OF IOWA.

ATTACHMENT FOR CALCULATING-MACHINES.

1,167,132. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed March 3, 1911. Serial No. 612,131.

To all whom it may concern:

Be it known that I, MARTIN TEETOR, a citizen of the United States, residing at Des Moines, county of Polk, and State of Iowa, have invented a new and useful Attachment for Calculating-Machines, of which the following is a specification.

My invention relates to calculating machines arranged to be driven by an electric motor, and has for its object the provision of novel mechanism for controlling the motor switch by means of a treadle.

As a further feature of improvement this mechanism includes a retarding device, so constructed that when the operator releases the treadle to open the motor switch, the opening of the switch does not take place immediately, but is delayed for a brief interval of time. The purpose of this retarding device is to permit the operator to leave the machine for a limited interval of time without the necessity of stopping the motor. In motor driven calculating machines heretofore constructed, the motor switch was controlled by hand and the operation of the switch was direct and immediate upon actuation of the switch handle or switch button. The control of the motor switch by means of a treadle gives the operator the freedom of both of his hands for the operation of the keyboard. The retarded or delayed operation of the switch upon release of the treadle permits the operator to leave the machine for a limited period of time without having to manipulate some form of stopping device for the motor. The retarding mechanism herein disclosed is also provided with means for regulating the amount of retardation in the operation of the motor switch.

In the accompanying drawings which illustrate a preferred form of my invention, Figure 1 represents a side elevation of a motor-driven calculating machine provided with my new attachment, Fig. 2 is a cross-sectional view of the retarding mechanism together with some of the associated connections, and Fig. 3 is an internal view of a suitable form of switch adapted to be connected with retarding mechanism.

On a suitable support or standard, indicated as a whole by the reference numeral 1, is mounted a calculating machine 2 of any approved form or construction. Inasmuch as this calculating machine does not in and of itself form any part of my invention, but may be of a form well known in the art, it is unnecessary here to give any detailed description thereof, since the construction and operation of such a machine is well understood by those skilled in the art. The support 1 carries an electric motor 3 which is arranged to be operatively connected with the power shaft 4 of the adding machine. For the sake of illustration I have in Fig. 1 shown an arm 5 connected to the power shaft 4 and a slotted link 6 depending from the free end of the arm 5. The connections between the motor shaft and the slotted link 6 are of any approved and well known form and are understood to be arranged within the box or casing 7 secured to the support 1.

The adding machine is also provided with a starting key 8 which is adapted to control a suitable clutch between the motor shaft and the slotted link 6, this clutch being arranged in the box or casing 7. Since the operative connections between the power shaft 4, the starting key 8 and the motor 3 do not in and of themselves form any part of my invention, I have not thought it necessary to show or describe in detail the mechanism contained within the box or casing 7, since such mechanism is well understood by those skilled in the art. The supply conductors 9 and 10 lead from a suitable source of electric energy to the motor windings. The support or standard 1 has fixed thereto a suitable form of electric switch 11. In the illustrations shown in the drawing, the motor switch 11 is depicted as what is known in the art as a flush-wall switch. Fig. 3 shows the operative parts of such a switch. The terminals 12 and 13 are secured to the metallic strips 14 and 15, respectively. Into the casing 16 extend the conductors 17 and 18. A binding post 19 secures the conductor 17 in electrical contact with the metal strip 14, and a binding post 20 holds the conductor 18 in electrical contact with the other metal strip 15. A metallic arm 21 pivoted at 22 is adapted to electrically connect the terminals 12 and 13, thereby closing the circuit through the motor windings. Rigidly connected to the metallic arm 21 is a lever 23 to which is pivoted the upper end of the link 24 provided with a slot 25. The switch casing 16 is provided with a pair of perforated lugs 26 and 27. The lug 26 is provided with a pin 28 on which is pivoted

the rod 29. To the lower end of this rod is rigidly secured the piston 30 which is arranged to operate within the cylinder 31. The piston 30 is in the form of a cylinder having a disk portion 32 provided with one or more valve openings 33. These openings are adapted to be normally closed by valves 34. The piston rod 29 carries a disk 35 which engages the upper ends of the valve stems 36. On the hub portion 37 of the piston disk 32 rests a cup-shaped disk 38 provided with openings for accommodating the valve stems 36. A coil spring 39 bearing at one end against the cup-shaped disk 38 and at the other end against the disk 35, normally holds the valves 34 firmly against their respective openings. The cylinder 31 is provided with a by-pass 40 which at one end communicates with the cylinder at the point 41 and at the other end at the point 42, these points of communication being at opposite sides of the piston 30. A needle valve 43 is arranged in the by-pass 40 for controlling the flow of oil or other suitable fluid with which the cylinder is filled. The cylinder is provided with a suitable stuffing box or gland 44 to render the connection between the cylinder and the piston rod airtight. The top of the cylinder is preferably closed by a cap 45 which may be screwed on to the cylinder. The cap 45 is provided with a pivot lug 46 to which is connected one end of a rod 47. The upper end of this link is provided with a pin 48 which is adapted to work in the slot 25 of the link 24. At its lower end the cylinder 31 has secured thereto the rod 49. A treadle 50 is at its rear end pivoted to the support 1 at 51 and at its front end terminates in a foot piece 52. The rod 49 is pivoted to the treadle 50 at 53. A spring 54 is at one end connected to the lug 27 of the switch box 16 and at the other end to the treadle 50, so as to normally hold the treadle in the position shown in Fig. 1.

From the above detailed description it will be apparent that when the operator depresses the treadle, the cylinder 31 is drawn down while the piston 30 remains stationary. This causes such a pressure of the oil or fluid in the cylinder on the disk 35 that the latter is depressed sufficiently against the action of the spring 39 to open the ports 33. This forces the oil or fluid through these ports and thereby permits ready movement of the cylinder relative to the piston. The downward movement of the piston 31 is accompanied by the downward movement of the link 24, whereby the motor switch is closed, as shown in Fig. 3. It is of course to be understood that the motor switch is normally open and that it is not in the closed position until the link 24 is drawn down by the cylinder 31. The switch remains closed as long as the operator keeps his foot on the treadle. Should the treadle be released, the spring 54 will draw the same upwardly and simultaneously move the cylinder 31 upwardly. During this upward movement of the cylinder the valves 34 remain closed and the oil in the cylinder is forced through the by-pass 40 from one side of the piston to the other. This circulation of the oil is comparatively slow because of the restricted area of the by-pass. It will, therefore, take a corresponding amount of time for the cylinder to rise to its normal position. The motor switch remains closed until the cylinder reaches the limit of its upward movement, whereupon the pin 48 forces the link 24 upwardly to open the switch. Should the operator depress the treadle before the cylinder has reached the limit of its upper movement, the motor circuit remains closed and he may continue the operation of the calculating machine without having to attend to any switch connections. The flow of oil or fluid through the by-pass 40 is regulated by the needle valve 43, but it is obvious that other means may be provided for regulating the rapidity of circulation of the oil. It is obvious that the length of time which it takes the cylinder to travel from its lower to its upper position depends upon the rate of flow of the oil through the by-pass 40. Therefore by regulating the effective area of the by-pass the amount of retardation in the operation of the motor switch may be accordingly regulated.

It should be understood that the particular form of switch which has been selected for illustration in the drawings for the sake of clearness, does not in and of itself form any part of my present invention and that any suitable form of circuit-controlling switch may be used.

I would also have it understood that while I have herein shown one specific embodiment of my invention, various changes and modifications may be resorted to without departing from the scope of the invention as defined in the appended claims. For instance, my new form of switch-operating mechanism is readily adapted for use in connection with various kinds of motor-driven appliances which are necessarily used intermittently and where the motor is instantly cut into circuit, but is cut out of circuit with retarded action of the controlling switch.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination of a machine, an electric motor for operating the same, a switch in the motor circuit, a treadle, a fluid-filled cylinder connected at one end to said treadle and at the other end to said switch, a stationarily supported piston within said cyl-

inder, one or more normally closed valves carried by said piston and arranged to open automatically when the cylinder is moved down by the operation of the treadle, and a by-pass connected to said cylinder at opposite sides of the piston.

2. The combination of a suitable support, a machine mounted thereon, an electric motor for operating said machine, a switch secured to said support for controlling the motor circuit, a treadle pivoted to said support, a fluid-filled cylinder connected at its lower end to said treadle, a lost-motion connection between said switch and said cylinder, a piston within said cylinder, a rod secured at one end to said piston and pivoted at its other end to said support, one or more normally closed valves carried by said piston and arranged to open automatically when the cylinder is moved down by the operation of the treadle, and a by-pass connected to said cylinder at opposite sides of the piston.

3. The combination of a suitable support, a driven machine mounted thereon, an electric motor for operating said machine, a switch secured to said support for controlling the motor circuit, a treadle pivoted to said support, a fluid-filled cylinder connected at its lower end to said treadle, a lost-motion connection between said switch and said cylinder, a piston within said cylinder, a rod secured at one end to said piston and pivoted at its other end to said support, one or more normally closed valves carried by said piston and arranged to open automatically when the cylinder is moved down by the operation of the treadle, a by-pass connected to said cylinder at opposite sides of the piston, and means for regulating the flow of fluid through said by-pass.

4. The combination of a suitable appliance, an electric motor for operating the same, a switch in the motor circuit, a treadle, operative connections between said treadle and said switch for controlling the latter, a retarding device included in said connections for retarding the operation of the switch when the treadle is released, and means for regulating the amount of retardation of said device.

5. The combination of a suitable support, a driven machine mounted thereon, an electric motor for operating said driven machine, a switch secured to said support for controlling the motor circuit, a treadle pivoted to said support and having connections with said switch for controlling the same, said connections including a device for retarding the operation of the switch when the treadle is released, a spring for normally holding the treadle in inoperative position, and means for regulating the amount of retardation of said device.

6. The combination of a suitable appliance, an electric motor for operating the same, a switch in the motor circuit, a treadle, a fluid-filled cylinder provided with a piston, a by-pass connected to said cylinder at opposite sides of said piston, one or more normally closed valves carried by said piston and arranged to open automatically under pressure of fluid in one direction, said cylinder and piston being movable relatively to each other, and operative connections whereby the depression of said treadle opens the switch and moves the piston relatively to the cylinder, the piston valves being open during this movement, while release of the treadle causes relative movement of piston and cylinder in the opposite direction, the piston valves being closed during this return movement and the fluid being forced through the by-pass.

7. The combination of an electric motor, a switch in the motor circuit, and mechanism for operating said switch, said mechanism operating instantly to close the switch and operating with retarded action to open the switch.

In witness whereof, I hereunto subscribe my name this 9th day of December, A. D. 1910.

MARTIN TEETOR.

Witnesses:
CLARENCE J. LOFTUS,
ELIZABETH SKAHILL.

NEXT ITEM

M. TEETOR.

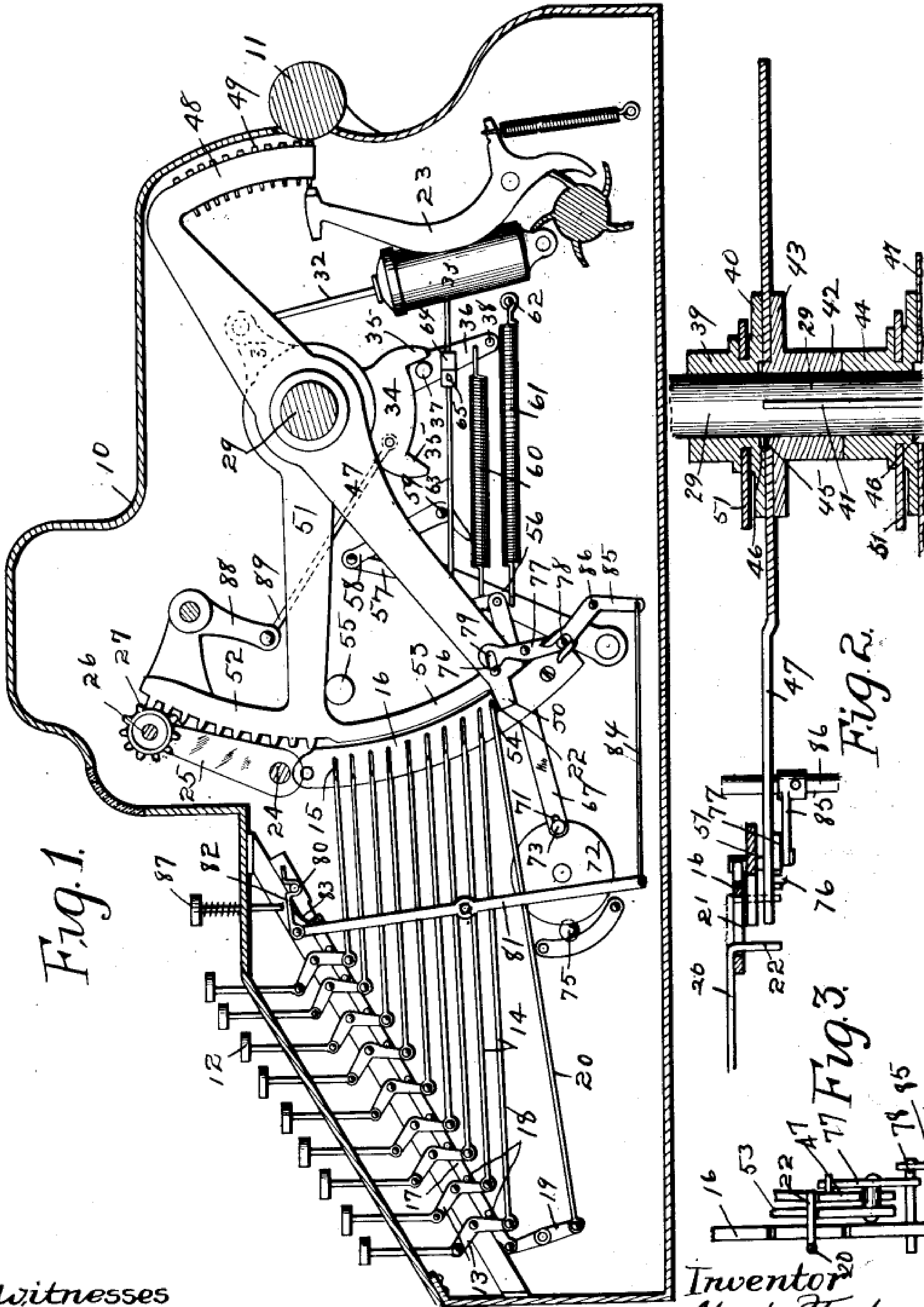
CALCULATING MACHINE.

APPLICATION FILED MAR. 25, 1909.

1,086,244.

Patented Feb. 3, 1914.

3 SHEETS—SHEET 1.



Witnesses

A. G. Hague

F. C. Dahlberg.

Inventor

Martin Teetor

by Orwig & Lane attys

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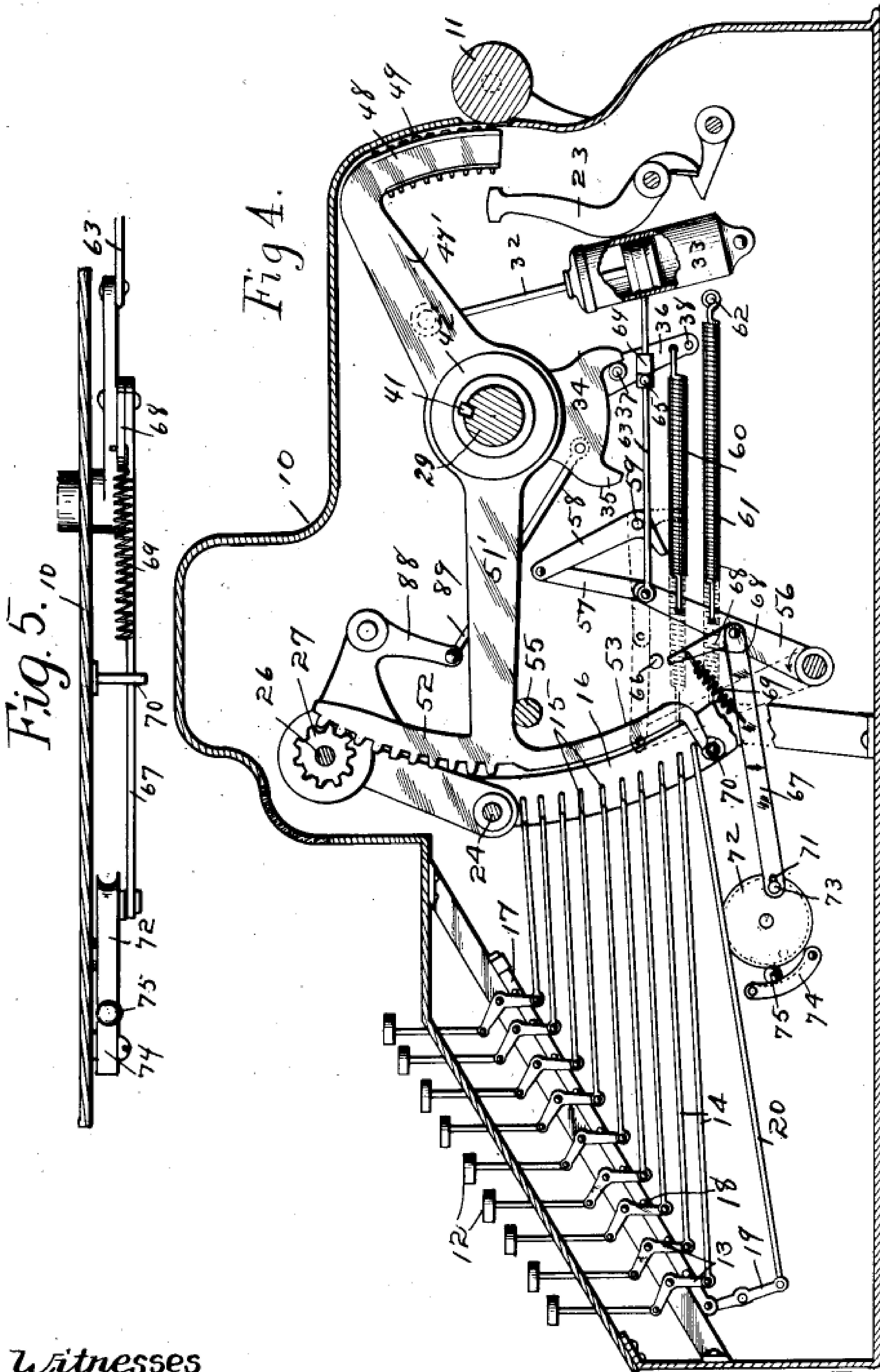
M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED MAR. 25, 1909.

1,086,244. Patented Feb. 3, 1914.

3 SHEETS—SHEET 2.



Witnesses
A. G. Hague
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane attys.

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M. TEETOR.

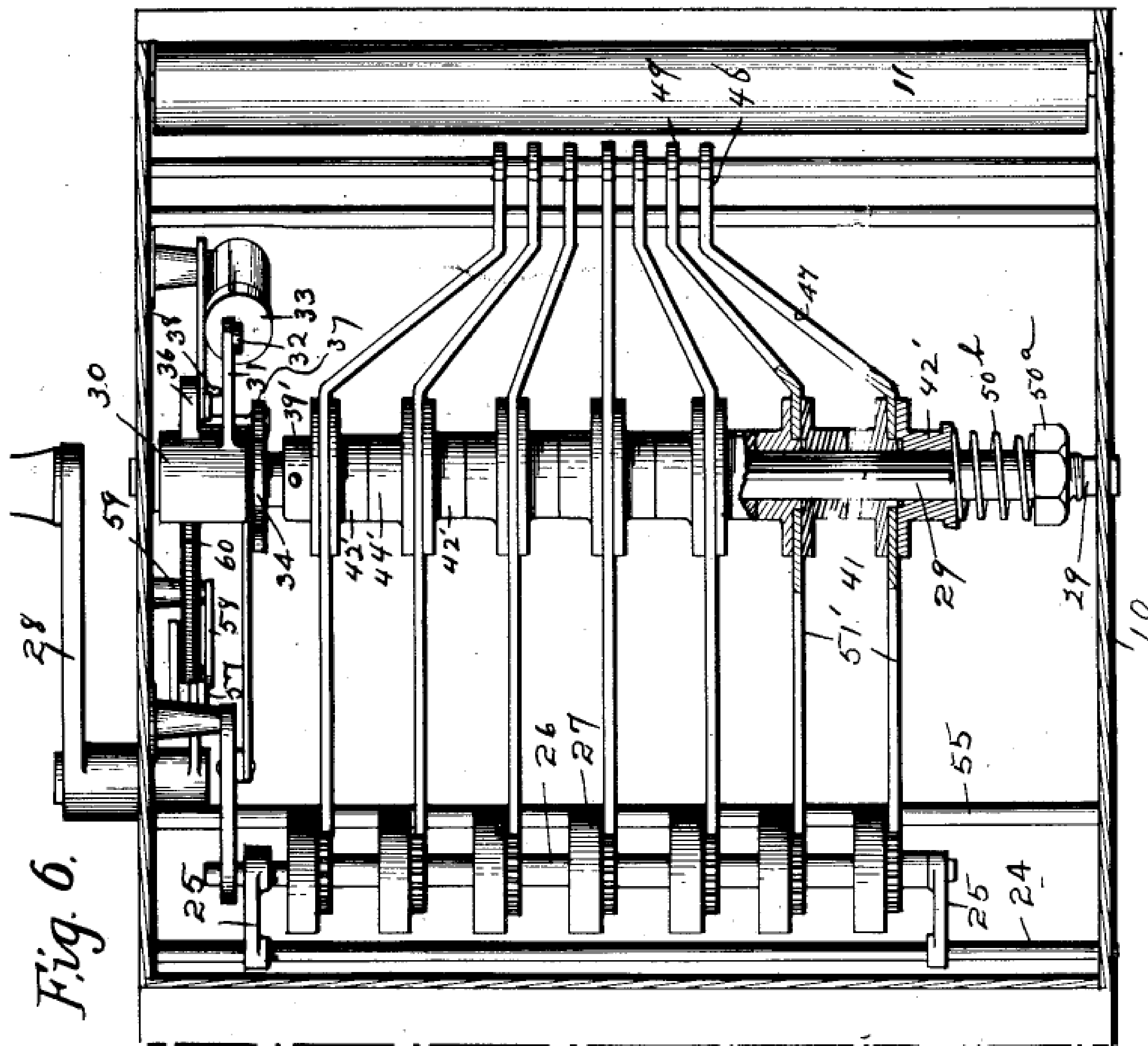
CALCULATING MACHINE.

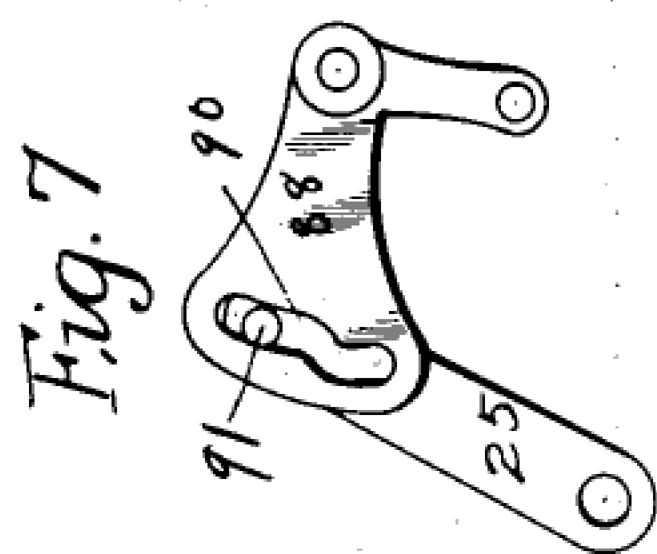
APPLICATION FILED MAR. 25, 1909.

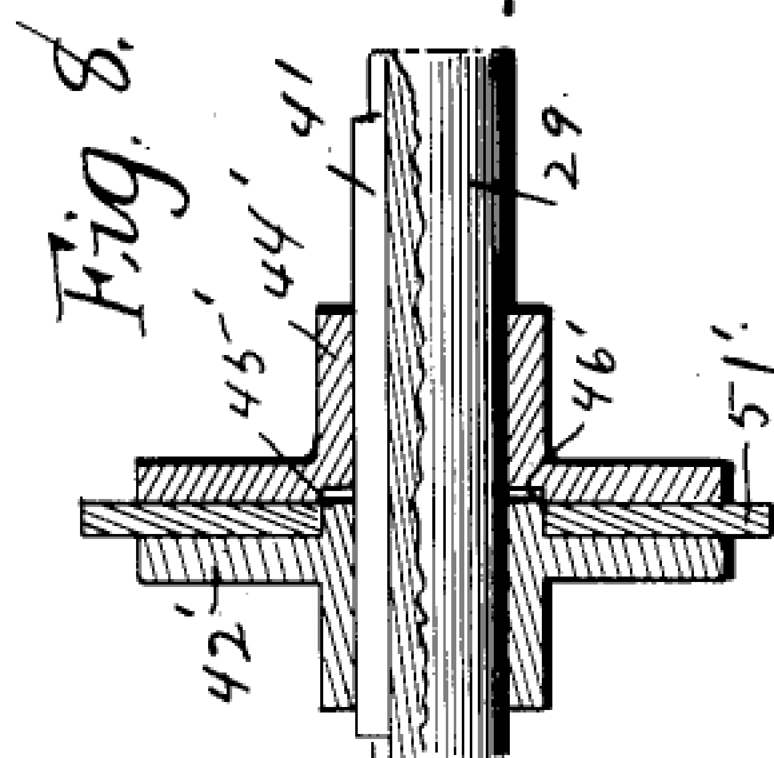
1,086,244.

Patented Feb. 3, 1914.

3 SHEETS—SHEET 3







Witnesses
A. G. Hague
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane attys.

1914 02 03 US1086244 p03.png

UNITED STATES PATENT OFFICE.

MARTIN TEETOR, OF DES MOINES, IOWA.

CALCULATING-MACHINE.

1,086,244. Specification of Letters Patent. Patented Feb. 3, 1914.

Application filed March 25, 1909. Serial No. 485,724.

To all whom it may concern:

Be it known that I, MARTIN TEETOR, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented a certain new and useful Calculating-Machine, of which the following is a specification.

My invention relates to and consists in certain new and useful improvements in calculating machines of the class in which the adding wheels are actuated by rack bars and the type are moved to printing position by being carried by type bearing levers actuated in unison with the rack bars.

My object is, broadly, to provide improved means for operating and controlling the movements of the rack bar and type bearing levers.

More specifically, it is my object to provide simple and durable means for connecting the type bearing levers with a supporting rock shaft in such a manner that the type bearing levers will be carried with the shaft by means of their frictional engagement, and then when the type bearing lever is stopped, the rock shaft may continue to rotate to the completion of its stroke without further moving the type bearing lever so that all of the type bearing levers that are actuated during the operation of the rock shaft will be carried with the rock shaft slowly and at uniform speed and then each will be held and retained in proper position for printing without any shock or jar to the machine or excessive wear on the operative parts.

A further object is to provide improved means of simple, and durable construction for automatically preventing the type bearing lever from moving backwardly after it has started on its operative movement, which means will be automatically released to permit a return movement of the type bearing lever when the rock shaft on which the type bearing levers are mounted has completed its movement.

A further object is to provide means for supporting the type bearing levers firmly in position with the type thereon in accurate printing position. In this connection, it is to be understood that the type bearing levers are mounted upon the rock shaft at points widely spaced apart and that the type bearing ends thereof are close together and that considerable difficulty has been experienced heretofore in keeping the type bearing ends of said levers accurately in alinement.

A further object is to provide simple, durable, and easily actuated means whereby the adding mechanism may be retained in an inoperative position without affecting the operation of the type bearing lever and other parts so that the machine may be used for printing purposes without changing the positions of the adding wheels.

My invention consists in the construction, arrangement, and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which—

Figure 1 shows a vertical, longitudinal sectional view of a calculating machine embodying my invention. Fig. 2 shows a detail plan view, partly in section, for illustrating the means for connecting the type bearing levers and the rack bar levers with the rock shaft and also the means for securing the type bearing lever to the rack bar lever. Fig. 3 shows a detail front view illustrating the lower portion of the slotted bar in which the rods that are connected with the type bearing levers are slidingly mounted and also the means for securing the type bearing lever to the rack bar lever. Fig. 4 shows a view similar to Fig. 1 of a modified form of my invention. Fig. 5 shows a detail plan view, partly in section, illustrating the means for preventing a return or downward movement of the type bearing levers until after they have completed their upward movement. Fig. 6 shows a top or plan view of the modified form illustrated in Fig. 4. Fig. 7 shows a detail side view of the device for automatically throwing the shaft of the adding wheels forwardly out of engagement with the rack bars, and Fig. 8 shows a detail, sectional view illustrating the means for connecting the rack bar and type bearing levers with the rock shaft, in the modified form of construction shown in Fig. 4.

In the following description, I shall first describe briefly the parts of the calculating machine which are shown in the drawings

but which, however, are of the ordinary construction now in common use, and which, therefore, of themselves form no part of my present invention except as they are necessary features of the combination.

The reference numeral 10 is used to indicate the frame of the calculating machine. At the rear of the frame is a printing platen 11. At the front of the machine are a number of series of key bars 12, there being one complete series for each type bearing lever. Each of the key bars is connected to a bell crank lever 13, and connected with each of the bell crank levers 13 is a rod 14 which is slidingly mounted in a corresponding slot 15 arranged in a stationary slotted bar 16. Therefore, when one of the key bars in the series is depressed, the corresponding rod 14 is moved rearwardly in the slot 15 and forms an obstruction to the upward movement of the type bearing levers as will hereinafter appear.

Mounted beneath each series of bell crank levers 13 is a slide-bar 17 having adjacent to each bell crank lever a pin 18 to be engaged by the bell crank lever when the key bar is depressed to thereby move the slide bar forwardly and upwardly. Connected with the lower end of the slide bar 17 is a pivoted lever 19, and a rod 20 is attached to the lower end of it and enters a slot 21 in the slotted bar 16. This rod is provided with an arm 22 to project through and beyond said slot, the arrangement being such that when any key bar in the series is depressed, the rod connected with it will be moved rearwardly and the rod 20 will be moved forwardly. At the rear of the machine frame is a printing hammer 23 of ordinary construction.

Mounted above the slotted bar 16 is a shaft 24 having the arms 25 pivoted thereto, said arms being designed to provide a support for the shaft 26 of the adding wheels 27. These adding wheels and the supporting means connected with them are of the ordinary construction now in common use and of themselves form no part of my present invention. Arranged at the left side of the machine frame is an operating crank 28.

The parts before mentioned are not described in detail for the reason that the construction and function of same are well known to persons skilled in the art, and for the further reason that they of themselves form no part of my present invention.

Mounted in the machine frame is a rock shaft 29 having fixed to one end a sleeve 30 on which there is an arm 31 connected to the plunger 32 of a dash-pot 33 of ordinary construction. Rotatably mounted on the shaft 29 adjacent to the sleeve 30 is an arm 34 extended downwardly and having two lugs 35 at its lower end spaced apart from each other. Fixed to the sleeve 30 is an arm 36 extended downwardly and provided with a pin 37 which pin is extended to a point between the lugs 35. Said arm 36 is also provided with a second pin 38 for purposes hereinafter made clear. The parts numbered 30 to 38 inclusive are common to both forms of construction. The operation of this part of the device is as follows:

When the lower end of the arm 36 is moved forwardly, the pin 37 will, after moving a short distance, strike the forward lug 35 of the arm 34 and it will then move the arm 34 forwardly and at the same time the piston 32 will be retarded in its movement by the dash-pot.

Referring to the form shown in Figs. 1, 2 and 3, it will be observed that fixed to the rock shaft 29 adjacent to the arm 34 is a collar 39 having a disk 40 at one end provided with a flat face. The said rock shaft is provided with a spline 41, and adjacent to the disk 40 is a second collar 42 having a disk 43 thereon, the face of which is adjacent to the flat face of the disk 40. This collar 42 is provided with a groove to receive the spline 41 so that the said collar 42 is slidingly and non-rotatably mounted upon the shaft. Adjacent to the collar 42 is a collar 44 similar to the collar 39 except that it is also provided with a groove to receive the spline 41 and is, therefore, slidingly and non-rotatably mounted on the rock shaft 29. A pair of collars 42 and 44 is provided for each of the type bearing levers of the machine, as clearly shown in Fig. 2. Each of the collars 42 is also provided, adjacent to the flat face of the disk 43, with an annular rib 45 designed to enter a corresponding groove 46 in the adjacent collar, as shown in Fig. 2.

Each type bearing lever comprises a body portion 47 having an opening therein to receive the annular rib 45 and the shaft 29, said type bearing lever being inserted between the adjacent flanges of the collars, as shown in Fig. 2. On the rear end of the type bearing lever 47 is a segmental arm 48 having type 49 therein designed to be engaged by the printing hammer 23 to force the type toward the printing platen 11, and on the forward end of the type bearing lever 47 is an extension 50 projected over the slotted bar 16 and designed to engage the rods 14 or 20.

In both forms of construction, on the rock shaft 29 at the end opposite from the sleeve 30 is an adjustable nut 50^a and an extension coil spring 50^b, the latter being mounted on the rock shaft between the nut and the adjacent one of the collars 42 so that all of said collars are yieldingly held by said spring toward each other and so that the type bearing levers are frictionally held in position between the disks.

Referring to Figs. 1, 2 and 3, the rack bar

lever comprises a body portion 51 loosely mounted in an annular groove formed in the collar 39, as shown in Fig. 2. The forward end of the said lever is provided with a segmental upwardly extended rack 52 and also with a segmental arm 53 extended downwardly. This arm 53 has a forwardly projected lug 54 at its lower end to extend over and adjacent to the slotted bar 16. A stop 55 is provided for limiting the downward movement of the rack bar lever. There is one of the rack bar levers provided adjacent to each of the type bearing levers. Only one of these rack bars is shown in Figs. 1 and 2 of the drawings, but it is to be understood that the type bearing levers and the rack bar levers are arranged in pairs throughout the entire machine.

By means of the arrangement of the type bearing and rack bar levers and connected parts before described, it is obvious that if the rock shaft 29 is turned without any one of the keys 12 being first depressed, the rod 20 will hold the forward end of the type bearing lever downwardly, and, therefore, the rock shaft will move without operating the type bearing lever or the rack bar as the friction caused by the spring 50^b is not sufficient to prevent a rotation of the rock shaft.

In both forms of construction shown I have provided for moving the rock shaft 29 by means of the crank 28 as follows: Fixed to the crank 28 is an arm 56 extended upwardly and having a link 57 pivoted to its upper end and connected to a bell crank lever 58, which lever is fulcrumed to a stationary pin 59. Connected to the arm 56 is a contractible coil spring 60 which is connected at its other end to the lever 36 and connected to the arm 56 is a second contractible coil spring 61 extended rearwardly and connected to a stationary pin 62. Pivoted to the arm 56 is a rod 63 extended through a small collar 64 pivoted to the arm 36. This rod 63 is provided with a stop 65 designed to engage said collar 64. The operation of this part of the device is as follows: Assuming the parts to be in the position shown by solid lines in Fig. 4, then if the arm 56 is moved forwardly to the position shown by dotted lines in said figure, the link 57 and the arm 58 will have their pivotal points extended a short distance below a horizontal line so that they will pass a dead center, and this downward movement will be limited by a stationary pin 66 so that the arm 56 is thereby locked by means of the link 57 and the lever 58 against rearward movement. This forward movement of the arm 56 will also cause tension to be applied to the spring 61. As soon as the pin 38 on the arm 36 strikes the lower end of the bell crank lever 59 it will raise the forward end of the bell crank lever 58 and the adjacent end of the link 57 so that the tension of the spring 61 will then be effective to return the arm 56 to its rearward limit. It is obvious, however, that said arm 56 cannot be returned until the pin 38 strikes upon the bell crank lever 58 to thereby elevate the joint between the parts 57 and 58. Then, when the arm 56 moves rearwardly, the rod 63 and the stop 65 thereon will engage the pivoted collar 64 and thus positively move the arm 36 rearwardly to its starting point. Therefore, when the operating crank is turned, the arm 56 is moved to its forward limit and locked; then the arm 36 is moved forwardly by spring pressure until it reaches its forward limit, whereupon it automatically unlocks the arm 56; and then the spring 61 moves the arm 56 rearwardly, and the stop 64 on the rod 63 then moves the arm 36 rearwardly.

In order to avoid the possibility of the arm 56 moving rearwardly before it has completed its forward movement, I have provided the following device: Pivoted to the central portion of the arm 56 is a bar 67 having connected with its pivot pin an upwardly extended arm 68 connected by a contractible spring 69 with the central portion of the bar 67. This arm 68 normally stands in an upright position, as shown in Fig. 4. Mounted on the slotted bar 16 is a stop 70 in position to be engaged by the arm 68 when at its forward limit of movement. In the forward end of the bar 67 is a slot 71. Pivoted to the machine frame is a disk 72 having a concave groove in its periphery and having a pin 73 secured to it and passed through the slot 71. Fixed to a stationary support adjacent to the forward side of the disk 72 is a segmental bar 74 also having a concave groove in its face that is adjacent to the disk 62. The said segmental bar is arranged eccentrically relative to the disk, it being nearest the disk at its lower end. Interposed between the segmental bar and the disk is a ball 75. In operation, this portion of the invention performs the following function: When the parts are in the position shown by solid lines in Fig. 4, then the forward movement of the arm 56 causes the disk 72 to be rotated approximately one-half of a revolution, and when the arm 56 is in the position shown by dotted lines in Fig. 4, the pivotal point of the bar 67 will be slightly below a line drawn through the ends of the bar 67 and through the center of the disk 72. If during this forward movement of the arm 56, the said arm 56 should be released, obviously, the spring 61 would tend to immediately move it rearwardly. This movement, however, would be checked and prevented by means of the ball 75 being wedged between the parts 74 and 72 as the said ball prevents any rotation of the disk 72 in a contrary clockwise direction, but does not

prevent said disk from moving clockwise. However, when the arm 56 has completed its forward stroke, then the arm 68 will strike upon the stop 70 and will cause the spring 69 to be placed under tension which will operate to press upwardly upon the forward end of the bar 67. This will be sufficient to cause the said forward end of the bar 67 to move upwardly a slight distance until it is above the center of the disk 72, whereupon the spring 61 will move the arm 56, and with it the bar 67, in a rearward direction. This means for preventing any backward movement of the arm 56 prior to the time when the forward movement is completed is very simple and inexpensive in construction and operates noiselessly, and is not liable to get out of repair. On the return stroke of the arm 56, the arm 67 moves by gravity past the dead center, as shown in Fig. 4, and is assisted into this position by the momentum of the disk 76 which is given rapid clock-wise rotation when the crank 28 is returned under the action of the spring 61. This movement of the bar 67 past the dead center on the return stroke is permitted by the slotted connection between the bar and the disk 72.

As before noted herein, in the form shown in Figs. 1, 2 and 3 the type bearing lever is frictionally held to the rock shaft 29 while the rack bar lever is loosely mounted thereon. In order to provide means for connecting these two levers so that they may properly operate in unison, I have provided the following mechanism: As shown in Fig. 1, on the forward end of the type bearing lever is a pin 76. On the lower end of the arm 53 of the rack bar lever is a small lever 77 having a pin 78 at its lower end and a slot 79 at its upper end. Obviously, when the slot of the lever 77 engages the pin 76, the two levers will be secured together so that they will move up and down in unison, and when the slotted end of the lever 77 is moved away from the pin 76, then the type bearing lever may move up and down without affecting the rack bar lever. It is obvious that it is desirable to connect these levers together whenever any key bar in the series corresponding to the levers has been depressed.

As previously described herein, there is a slide bar 17 that is moved rearwardly and upwardly whenever any key bar is depressed. On the upper end of this slide bar, I have provided a pin 80, and pivoted to a stationary support is a lever 81 having an arm 82 at its upper end provided with a notch to receive the pin 80. The arm is held in position with the notch adjacent to the pin by means of a spring 83 so that whenever the slide bar 17 is moved rearwardly, the upper end of the lever 81 also moves rearwardly. Connected to the lower end of the lever 81 is a rod 84 extended rearwardly and pivoted to a lever 85. The upper end of the lever 85 is provided with an open-ended slot designed to receive the pin 78. This lever 85 is pivoted to a stationary pivot pin 86. These parts are so arranged and combined relative to each other that they will operate as follows: Assuming the parts to be in the position shown in Fig. 1, then, obviously, the type bearing lever 47 could move upwardly at its forward end without affecting the rack bar lever 51. Assuming, however, that the lever 81 is operated by means of the slide bar 17 and its lower end moved forwardly, then the lever 85 will cause the upper end of the lever 77 to be moved forwardly so that the pin 76 will enter the slot 79. Then, when the forward end of the type bearing lever moves upwardly, it will carry with it the rack bar lever. In other words, the two levers will be connected with each other and will move in unison, and when said levers return to their lower limit of movement, the pin 78 will enter the slot of the lever 85. One of the advantages gained by this construction of independent levers for the type and rack bar and the means for connecting them is that it enables the operator to use the type bearing levers for printing purposes without causing any operation whatever of the rack bar levers, and, in order to accomplish this purpose, I have provided a spring-actuated key 87 arranged above each of the levers 82. By pressing downwardly upon the key bar 87, the lever 82 is forced below the pin 80 and the lever 81 is thereby held in the position shown by solid lines in Fig. 1. Then, if a key 12 is depressed, the rod 20 will be withdrawn forwardly and the type bearing lever will move upwardly until it strikes the rod of the depressed key, whereupon the printing is accomplished in the ordinary way and the rack bar lever is not moved during such operation. This desirable result, of course, cannot be accomplished unless the type bearing lever and the rack bar levers are separate and independent. However, there is no disadvantage occasioned by the use of the independent levers for the reason that the means for connecting them is of extremely simple construction, positive in its action, and not liable to get out of order.

In machines of this class, it is necessary to provide some means for moving the adding wheels forwardly out of engagement with the rack bars when the rack bars are at their upper limit of movement so that the adding wheels will not be turned backwardly when the rack bars are moved downwardly. For this purpose, I have provided the following mechanism: Pivoted to a stationary support is a bell crank lever 88 connected at one end by means of a rod 89 with

the arm 34, and having in its other end a slot 90 with an inclined portion in its center, as clearly shown in Fig. 7. The adjacent one of the arms 25 is provided with a pin 91 to enter the slot 90. By this arrangement, upon a forward movement of the arm 34, the forward portion of the bell crank lever 88 will be moved upwardly, which, on account of the pin 91 and slot 90, will cause the arm 25 to move forwardly far enough to throw the adding wheels 27 out of engagement with the rack bars. Then, upon a rearward movement of the arm 34, the adding wheels are again returned to normal position.

In the modified form shown in Figs. 4, 6 and 8, the construction and operation of the parts is the same as that hereinbefore described, except that the rack bar lever 51′ and the type bearing lever 47′ are both formed complete in one piece and are connected to the shaft 29 in the same manner as the type bearing lever in the form of the machine before described. The frictional connection between combined lever 47′—51′ and the rock shaft 29 is precisely the same as the connection between the rock shaft and the type bearing lever 47 of the construction shown in Figs. 1, 2 and 3, the only difference being that the collars 39′ and 44′ are not provided with the annular groove or recess formed on the collars 39 and 44. This groove or recess is not necessary in the modified form because the rack bar lever is formed integral with the type bearing lever. From Fig. 8 it will be seen that the combined type bar lever and type bearing lever 51′—47′ is frictionally held between the collars 42′ and 44′; the latter being provided with a recess 46′ for receiving the annular rib 45′ of the collar 42′. By reason of combining these two levers in one in the modified form, I dispense with the mechanism for detachably connecting the forward ends of said levers consisting of the parts 77 to 87, inclusive. In this way the construction of the machine is somewhat simplified, but I do not attain the desirable result of providing a machine in which the type bearing levers may be actuated without actuating the rack bar levers, and, in some instances, the independent operation of the type bearing levers is important and valuable. In all other respects, the construction and operation of the mechanism is the same in the modified form as in the form particularly and fully described herein.

One of the important advantages gained by my invention is that the movement of the type bearing lever to operative position is positive and is not dependent upon the uncertain and unequal action of springs for causing said movement, and furthermore, when the movement of the type bearing lever to printing position is obstructed, the rock shaft will continue its movement to the end of the stroke and there will be no appreciable shock or jar to the machine caused by the stopping of the type bearing lever or the continued movement of the rock shaft after the type bearing lever stops. Furthermore, this principle of operation of the type bearing levers results in a construction of great simplicity and durability.

Another one of the important advantages in connection with the invention herein set forth arises from the use of the ball clutch device acting in conjunction with the disk 72. This structure is extremely simple and durable and yet will positively prevent a return movement of the operating crank until its stroke has been completed, and, at the same time, at the completion of the stroke of the operating crank, the ball clutch device is released in such a manner that the return movement of the lever 56 is not in any way interrupted or impeded. Furthermore, the ball clutch device is noiseless in its operation.

Another one of the advantages gained by my invention is that by supporting each type bearing lever between two large friction disks, the lever is firmly held against twisting strains. This is desirable for the reason that the pivotal supports of the levers are necessarily widely separated while the type bearing ends thereof must be close together so that the shape of the type bearing levers or most of them is irregular and comprises a considerable lateral bend as shown in Fig. 6. Therefore, by means of my improved lever supporting disks, any lateral strain upon the type bearing levers will not throw the type bearing ends out of line, and I, therefore, increase the durability of the machine by preventing the type bearing levers from getting out of alinement.

I claim as my invention.

1. In a device of the class described, a lever carrying movable type at one end, a rock shaft serving as a support for said lever, a friction connection between said rock shaft and said lever, and means for operating the rock shaft.

2. In a device of the class described, a type bearing lever, a friction support for the type bearing lever, and means for operating the friction support, and means for retarding the movement of the type bearing lever.

3. In a device of the class described, the combination of a lever carrying movable type at one end, a swinging support for said lever, friction means for yieldingly holding the type-bearing lever to the support, and means for swinging the support to swing said lever and its type.

4. In a device of the class described, the combination of a type bearing lever, a support for same, friction means for yieldingly holding the type bearing lever to the sup-

port, and means for operating the support, and means for retarding the movement of the type bearing lever.

5. In a device of the class described, the combination of a rock shaft, a friction device mounted on the rock shaft, a type bearing lever frictionally supported by said friction device, and means for operating the rock shaft.

6. In a device of the class described, the combination of a rock shaft, a friction device mounted on the rock shaft, a type bearing lever frictionally supported by said friction device, and means for operating the rock shaft, and means for retarding the movement of the type bearing lever.

7. In a device of the class described, the combination of a rock shaft, a friction disk fixed thereto, a second friction disk adjacent to the first, means for yieldingly holding one of said disks toward the other, and a type bearing lever mounted on the shaft between said disks.

8. In a device of the class described, the combination of a rock shaft, a friction disk fixed thereto, a second friction disk adjacent to the first, means for yieldingly holding one of said disks toward the other, and a type bearing lever mounted on the shaft between said disks, said latter friction disk being slidingly and non-rotatably mounted on the shaft.

9. In a device of the class described, the combination of a rock shaft, a friction disk fixed thereto, a second friction disk adjacent to the first slidingly and non-rotatably mounted on the shaft, and a series of pairs of friction disks slidingly and non-rotatably mounted on the shaft, a spring in engagement with the end one of said friction disks opposite from the fixed friction disk for yieldingly holding all of the pairs of disks toward each other, and a type bearing lever mounted between each pair of said disks.

10. In a device of the class described, the combination of a rock shaft, means for operating it, two friction disks mounted upon said shaft, one of them being provided with an annular rib and the other with a co-acting annular groove, and a type bearing lever mounted on the shaft and in engagement with said annular rib and arranged between said disks.

11. In a device of the class described, the combination of a rock shaft, means for operating it, two friction disks mounted upon said shaft, one of them being provided with an annular rib and the other with a co-acting annular groove, and a type bearing lever mounted on the shaft and in engagement with said annular rib and arranged between said disks, and means for yieldingly holding the disks toward each other.

12. In a device of the class described, the combination of a frictionally controlled type bearing lever and a lever designed to actuate adding wheels, said levers being capable of independent operation.

13. In a device of the class described, the combination of a frictionally controlled type bearing lever and a lever designed to actuate adding wheels, said levers being capable of independent operation, and means for connecting said levers for operation jointly.

14. In a device of the class described, the combination of a rock shaft, a frictionally controlled type bearing lever connected with the rock shaft for movement in unison with it, a lever for actuating adding wheels loosely mounted on said shaft and capable of independent movement relative to the type bearing shaft, and means for connecting said levers for joint operation.

15. In a device of the class described, the combination of a rock shaft, a friction device mounted thereon, a type bearing lever supported by said friction device, a rack bar lever rotatably mounted upon said rock shaft and capable of independent movement relative to the type bearing lever, and means for connecting said levers for joint operation.

16. In a device of the class described, the combination of a type bearing lever and a rack bar lever capable of independent movement, a pin carried by one of said levers, a hook carried by the other, and means for throwing the hook into engagement with the pin for connecting said levers for joint operation.

17. In a device of the class described, the combination of a type bearing lever, a rack bar lever capable of movement independent of the type bearing lever, a series of key bars, and means actuated upon a depression of any one of the key bars of the series for connecting said levers for joint operation.

18. In a device of the class described, the combination of a type bearing lever, a rack bar lever capable of movement independent of the type bearing lever, a series of key bars, and means actuated upon a depression of any one of the key bars of the series for connecting said levers for joint operation, and means for automatically disconnecting said levers upon a return movement of the levers.

19. In a device of the class described, the combination of a type bearing lever, a rack bar lever capable of movement independent of the type bearing lever, a series of key bars, and means actuated upon a depression of any one of the key bars of the series for connecting said levers for joint operation, and means for holding said lever connecting devices out of operation so that one of them may move independently of the other.

20. In a device of the class described, the

combination of a rock shaft, a type bearing lever and a rack bar lever mounted thereon and capable of independent movement, a latch device for connecting said levers for joint operation, a series of key bars for said levers, a slide bar arranged to be moved upon a depression of any one of said key bars, a lever connected with said slide bar, a link connected with said lever, a lever connected with said link and having an open-ended slot therein, a hook carried by the rack bar lever and having a pin thereon to engage the lever with the open-ended slot, and a pin carried by the type bearing lever to be engaged by said hook, said parts being so arranged that upon a depression of any key bar, the said hook will be thrown into engagement with said pin, and the type bearing lever and the rack bar lever will be connected by said hook and pin for joint operation.

21. In a device of the class described, the combination of a rock shaft, a type bearing lever and a rack bar lever mounted thereon and capable of independent movement, a latch device for connecting said levers for joint operation, a series of key bars for said levers, a slide bar arranged to be moved upon a depression of any one of said key bars, a lever connected with said slide bar, a link connected with said lever, a lever connected with said link and having an open-ended slot therein, a hook carried by the rack bar lever and having a pin thereon to engage the lever with the open-ended slot, and a pin carried by the type bearing lever to be engaged by said hook, said parts being so arranged that upon a depression of any key bar, the said hook will be thrown into engagement with said pin, and the type bearing lever and the rack bar lever will be connected by said hook and pin for joint operation, and means for holding said hook in position out of engagement with its pin comprising a pin connected to said slide bar, a spring actuated arm having a notch therein in engagement with said pin, said arm being pivoted to the lever that is connected to the slide bar, and a key mounted above said spring actuated arm and so arranged that when depressed it will move the spring actuated arm from position out of engagement with the pin so that the slide bar may operate without moving the lever.

22. In a device of the class described, the combination of an operating crank, a clutch device connected therewith to prevent backward movement thereof, and a frictionally controlled type bearing lever operatively connected with said operating crank.

23. In a device of the class described, the combination of an operating crank and clutch device connected therewith to prevent backward movement thereof, a frictionally controlled type bearing lever operatively connected with said operating crank and means for retarding the movement of the type bearing lever.

24. In a device of the class described, the combination of an operating crank, a bar connected with it, a disk having a concave groove in its periphery and having said bar pivoted to it, a segmental clutch member having a convex groove therein arranged eccentrically relative to the disk, and a ball interposed between them.

25. In a device of the class described, the combination of an operating shaft, a bar pivoted to it, a disk pivoted to the bar, a clutch device arranged to act on said disk, said parts being so arranged that when the operating crank is in normal position, the point of attachment of the bar with the disk will be slightly below a line drawn from the pivotal point of the bar at one end through the pivotal point of the disk, and when said operating crank is being moved to its other limit, the disk will be moved slightly less than a half revolution and the pivotal point of the bar with the disk will be slightly below a line drawn through the pivotal point of the other end of the bar and the pivotal point of the disk.

26. In a device of the class described, the combination of an operating shaft, a bar pivoted to it, a disk pivoted to the bar, a clutch device arranged to act on said disk, said parts being so arranged that when the operating crank is in normal position, the point of attachment of the bar with the disk will be slightly below a line drawn from the pivotal point of the bar at one end through the pivotal point of the disk, and when said operating crank is being moved to its other limit, the disk will be moved slightly less than a half revolution and the pivotal point of the bar with the disk will be slightly below a line drawn through the pivotal point of the other end of the bar and the pivotal point of the disk, and spring actuated means for imparting an upward movement to the end of the bar that is pivoted to the disk at the time when the bar is in its last named position.

27. In a device of the class described, the combination of an operating shaft, a bar pivoted to it, a disk pivoted to the bar, a clutch device arranged to act on said disk, said parts being so arranged that when the operating crank is in normal position, the point of attachment of the bar with the disk will be slightly below a line drawn from the pivotal point of the bar at one end through the pivotal point of the disk, and when said operating crank is being moved to its other limit, the disk will be moved slightly less than a half revolution and the pivotal point of the bar with the disk will be slightly below a line drawn through the pivotal point of the other end of the bar and the pivotal point of the disk, a spring actuated means

for imparting an upward movement to the end of the bar that is pivoted to the disk at the time when the bar is in its last named position, said means comprising an arm pivoted to the bar, a spring connecting said arm and the bar, and a stationary pin to be engaged by said arm when the bar and disk are in their last named position.

28. In a device of the class described, the combination of a rock shaft, a series of frictionally controlled type bearing levers mounted thereon, and means for cushioning the movement of said rock shaft.

29. In a device of the class described, the combination of a rock shaft, a series of frictionally controlled type bearing levers mounted thereon, and a dash-pot for cushioning the movement of said rock shaft.

30. In a device of the class described, the combination of a rock shaft, a series of type bearing levers frictionally held to said rock shaft, and a dash-pot arranged for cushioning the movement of the rock shaft.

31. In a device of the class described, the combination of indicating wheels, means for operating the same any predetermined amount, printing mechanism operatively connected for printing the amount entered in the indicating wheels, said mechanism including a plurality of type bearing levers, a friction support for each lever, and means for operating said friction support.

32. In a calculating machine, the combination of a plurality of type bearing levers, a friction support for each lever, means for operating said friction supports, a plurality of indicating wheels operative in conjunction with said type bearing levers, and a keyboard for controlling the operation of said wheels.

Des Moines, Iowa, Mar. 5, 1909.

MARTIN TEETOR.

Witnesses:
W. R. Lane,
Mildred B. Goldizen.

NEXT ITEM

M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 20, 1908.

1,252,738.

Patented Jan. 8, 1918.
19 SHEETS—SHEET 1.

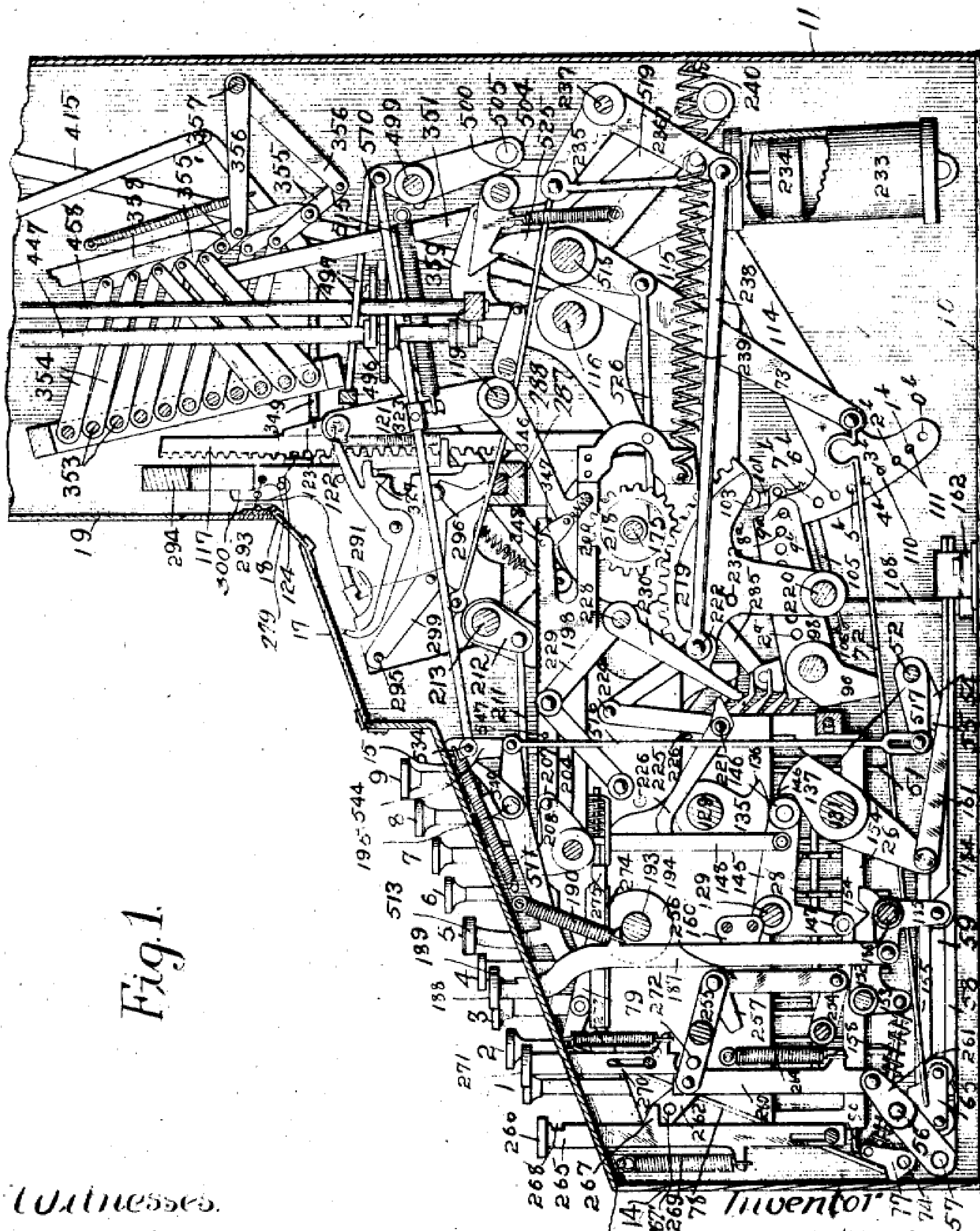


Fig. 1.

Witnesses.
A. G. Hagne
F. C. Dahlberg

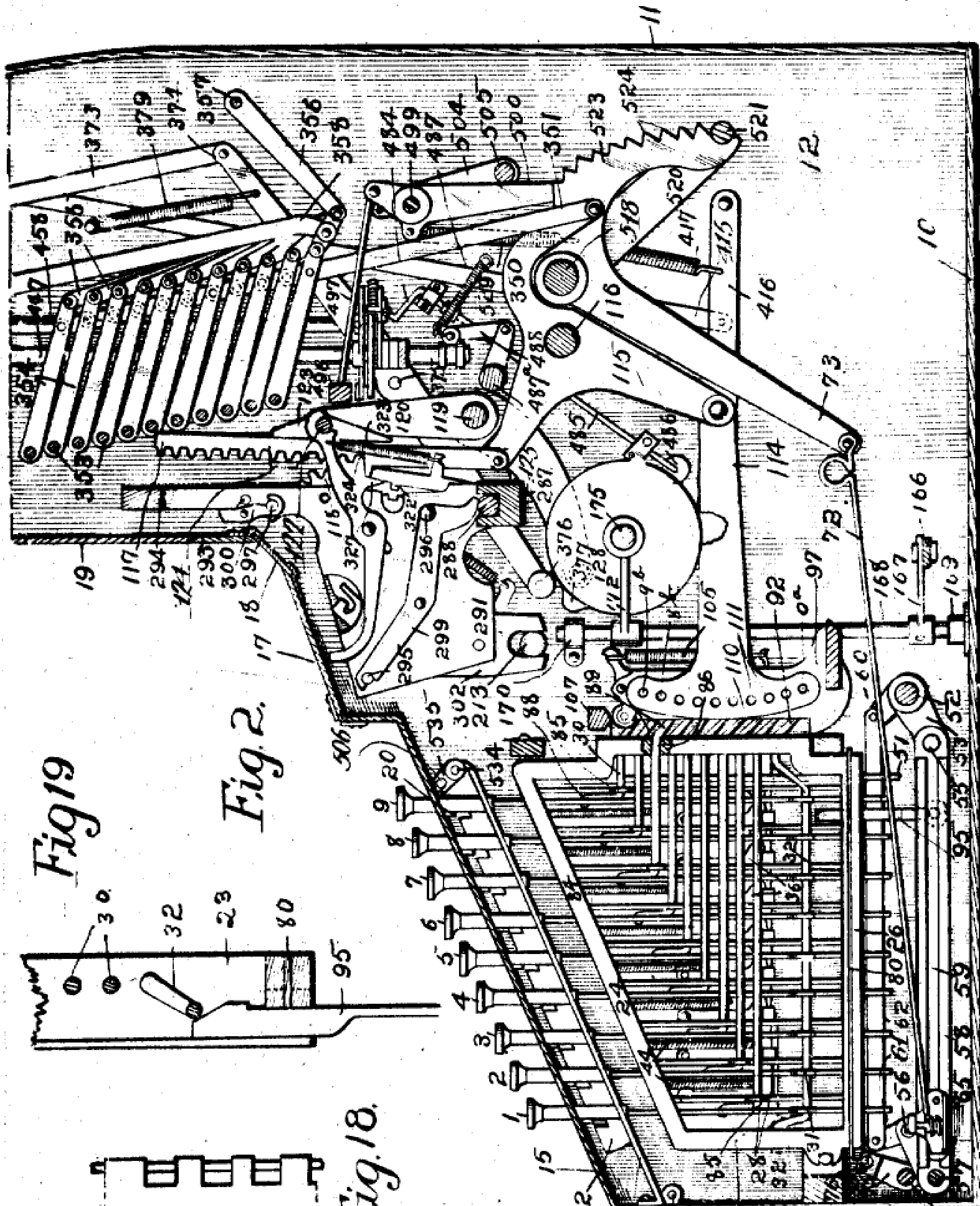
Inventor
Martin Teetor
by Orwig & Lane Att'ys.

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CALCULATING MACHINE.
APPLICATION FILED APR. 20, 1908.

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19 SHEETS—SHEET 2.



Witnesses.
A. G. Hague.
F. C. Dahlberg.

Inventor
Martin Teetor.
by Orwig & Lane Attys

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19 SHEETS—SHEET 3.

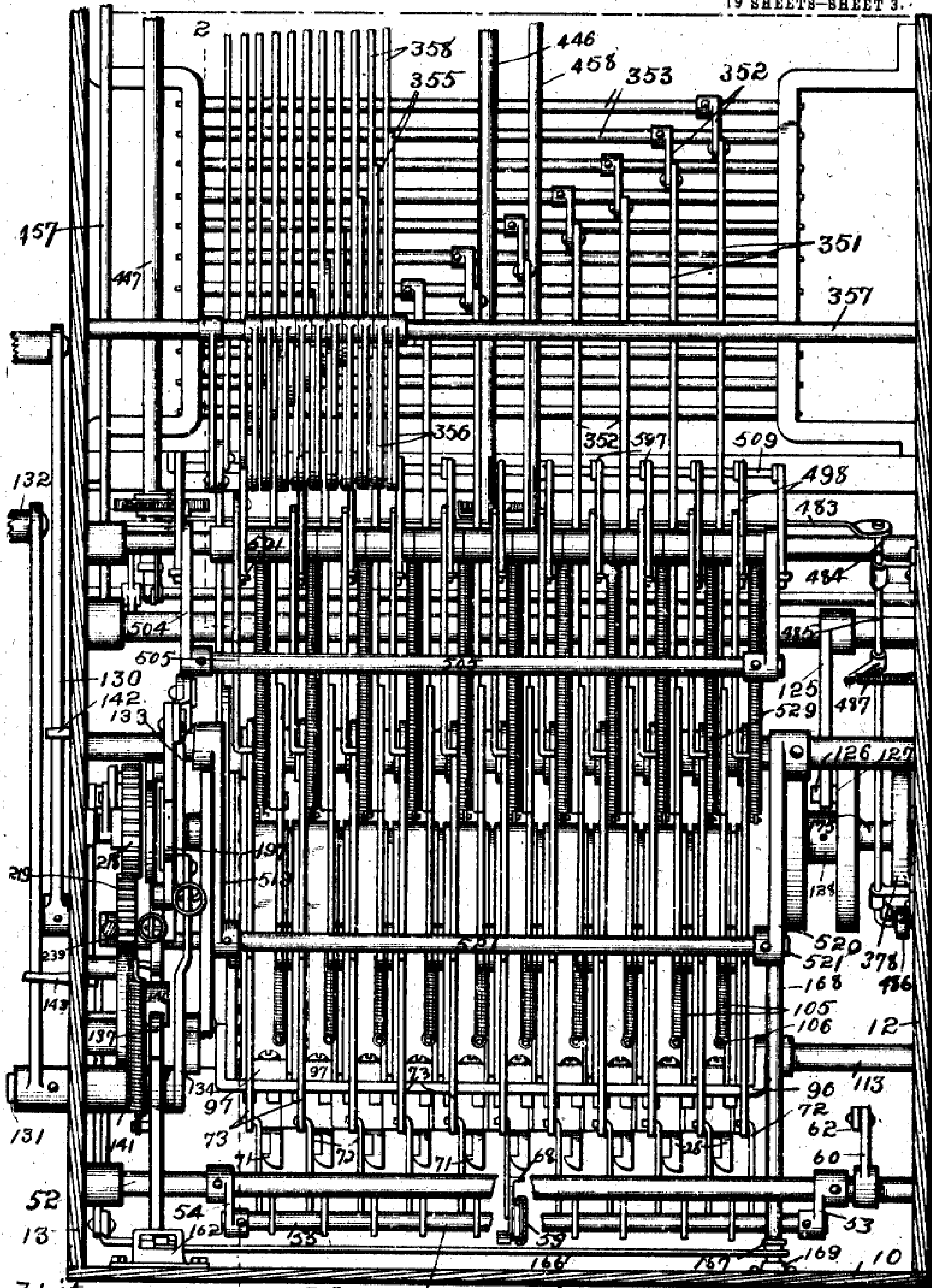


Fig. 3.

Witnesses
A. G. Hague
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane Attys

M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 20, 1908.

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19 SHEETS—SHEET 4.

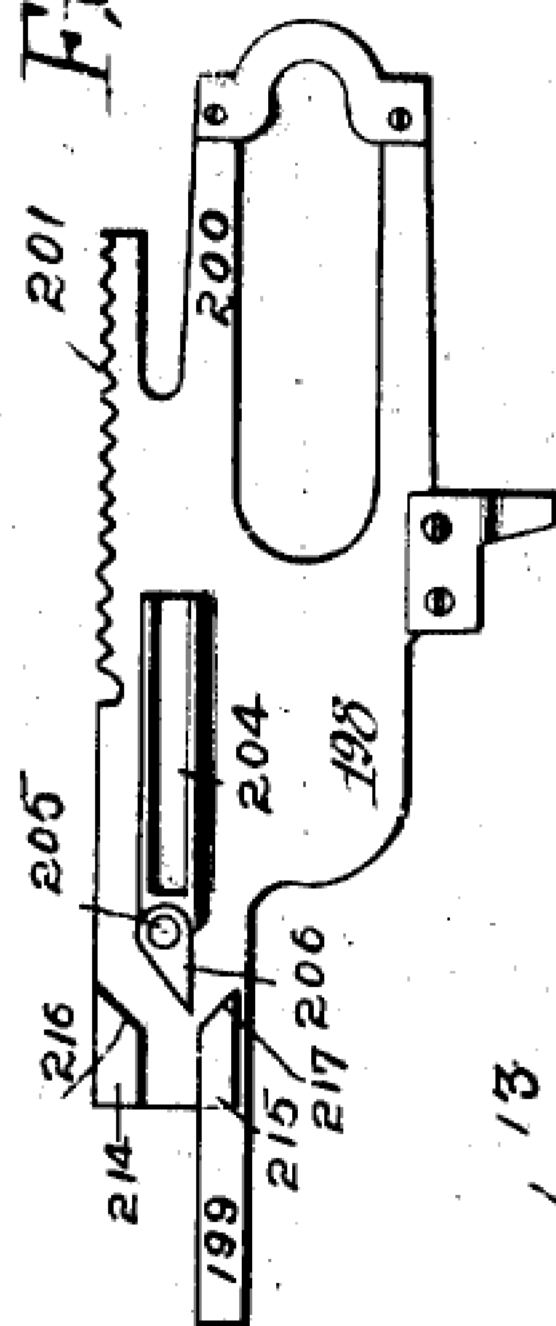


Fig. 33

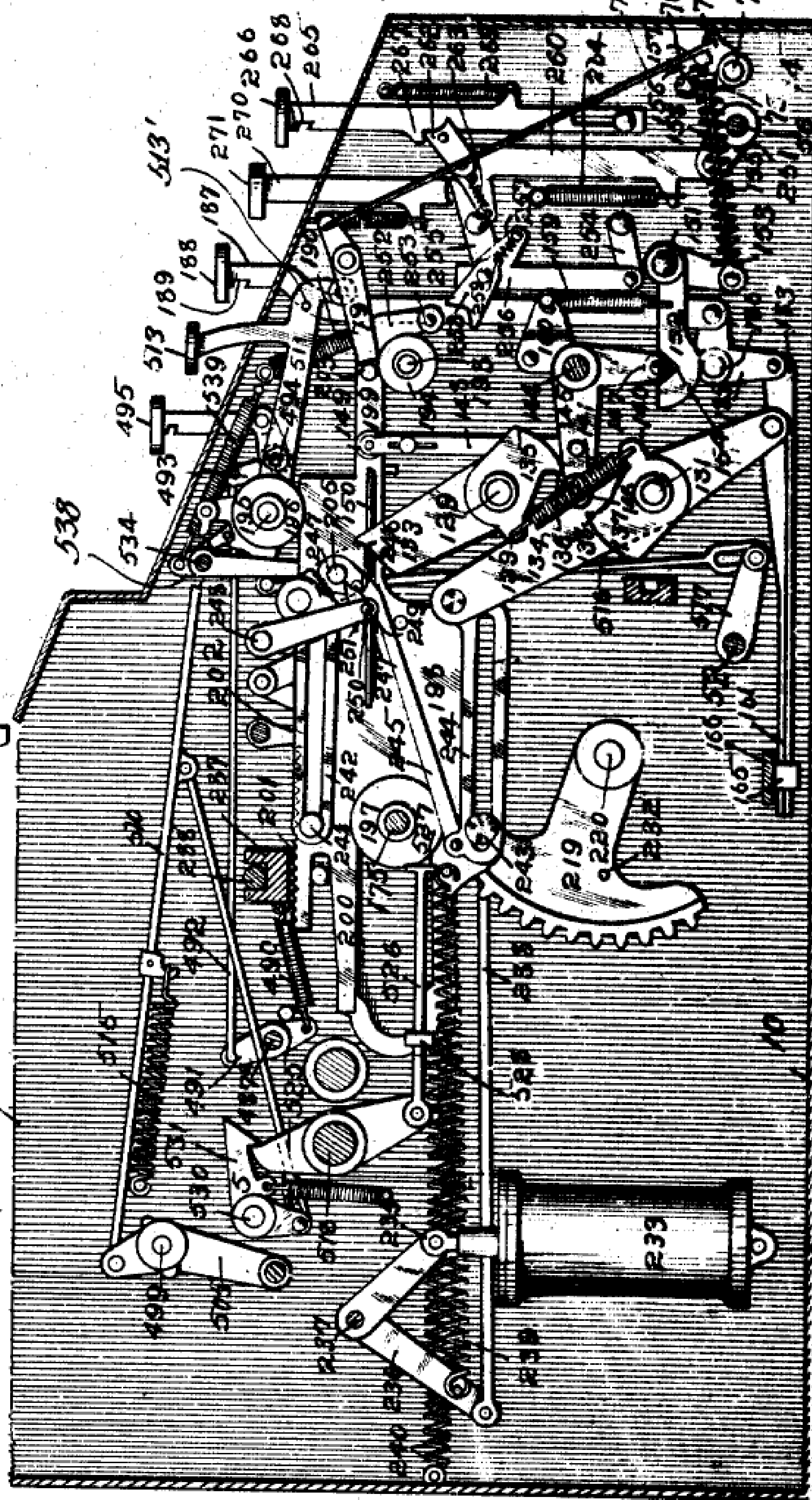


Fig. 4.

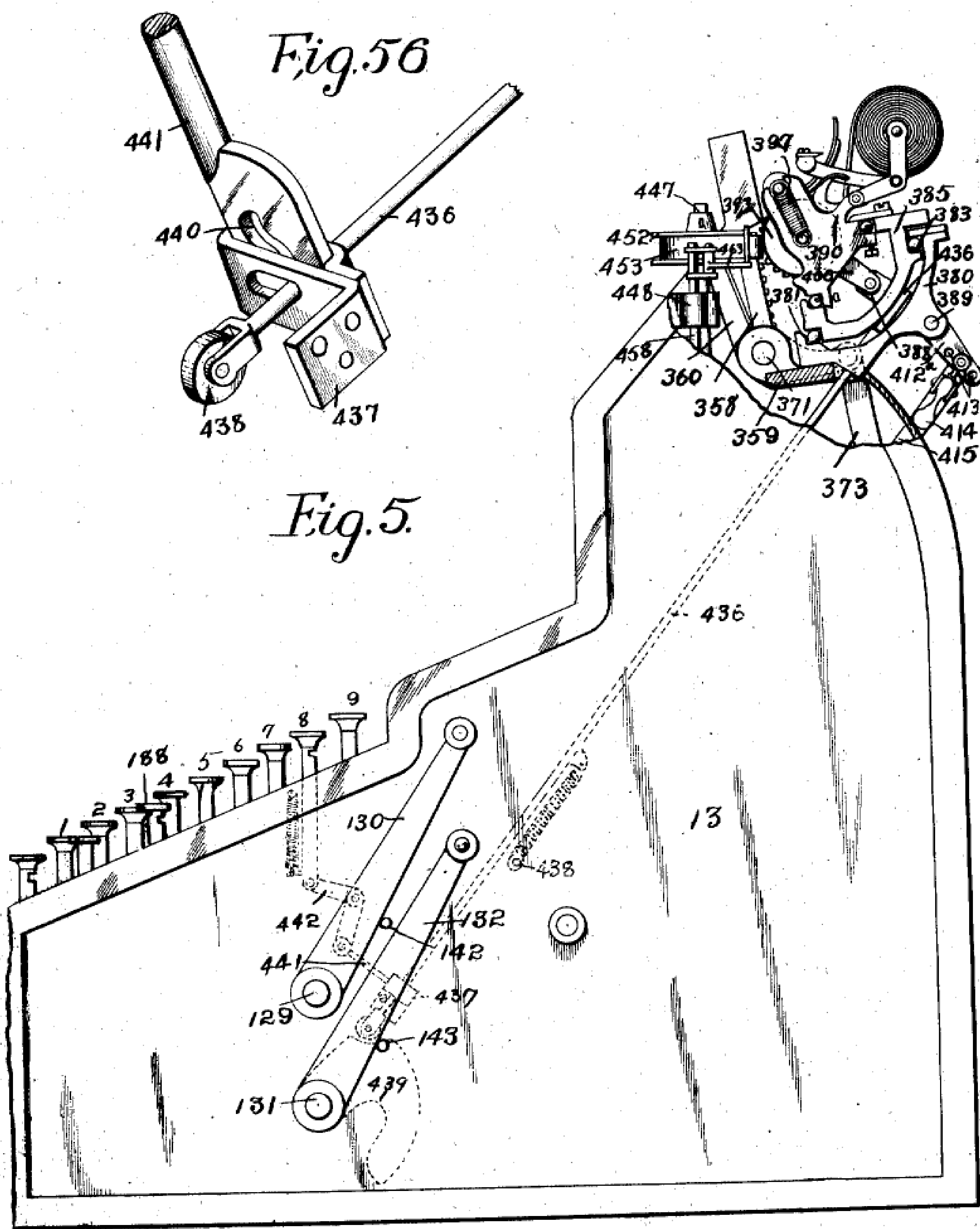
Witnesses
A. G. Hague
F. C. Dahlberg.

Inventor
Martin Teetor.
by Orwig & Lane Attys

M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 20, 1908.

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Patented Jan. 8, 1918.
19 SHEETS—SHEET 5.



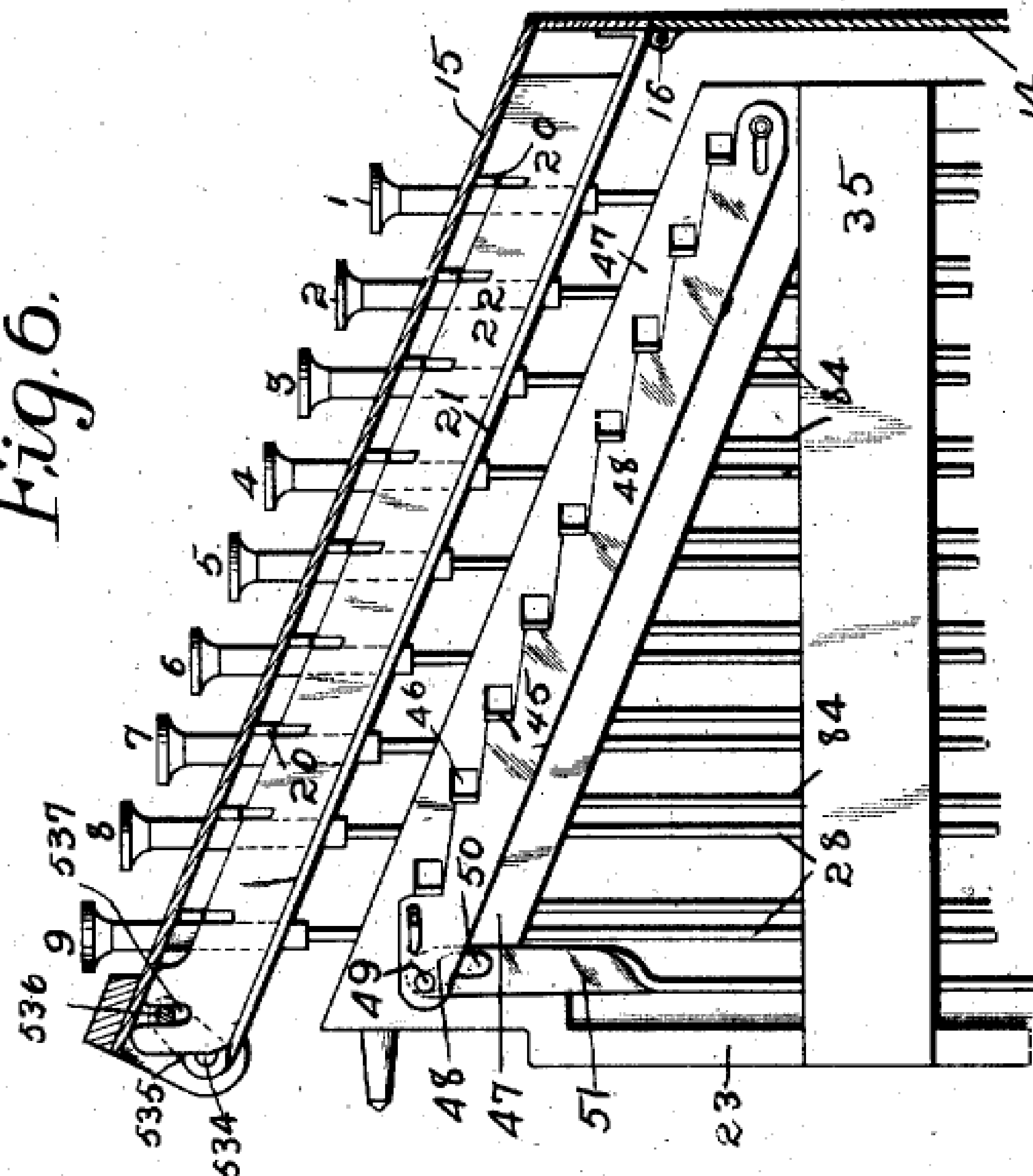
Witnesses
A. G. Hague
T. C. Dahlberg.

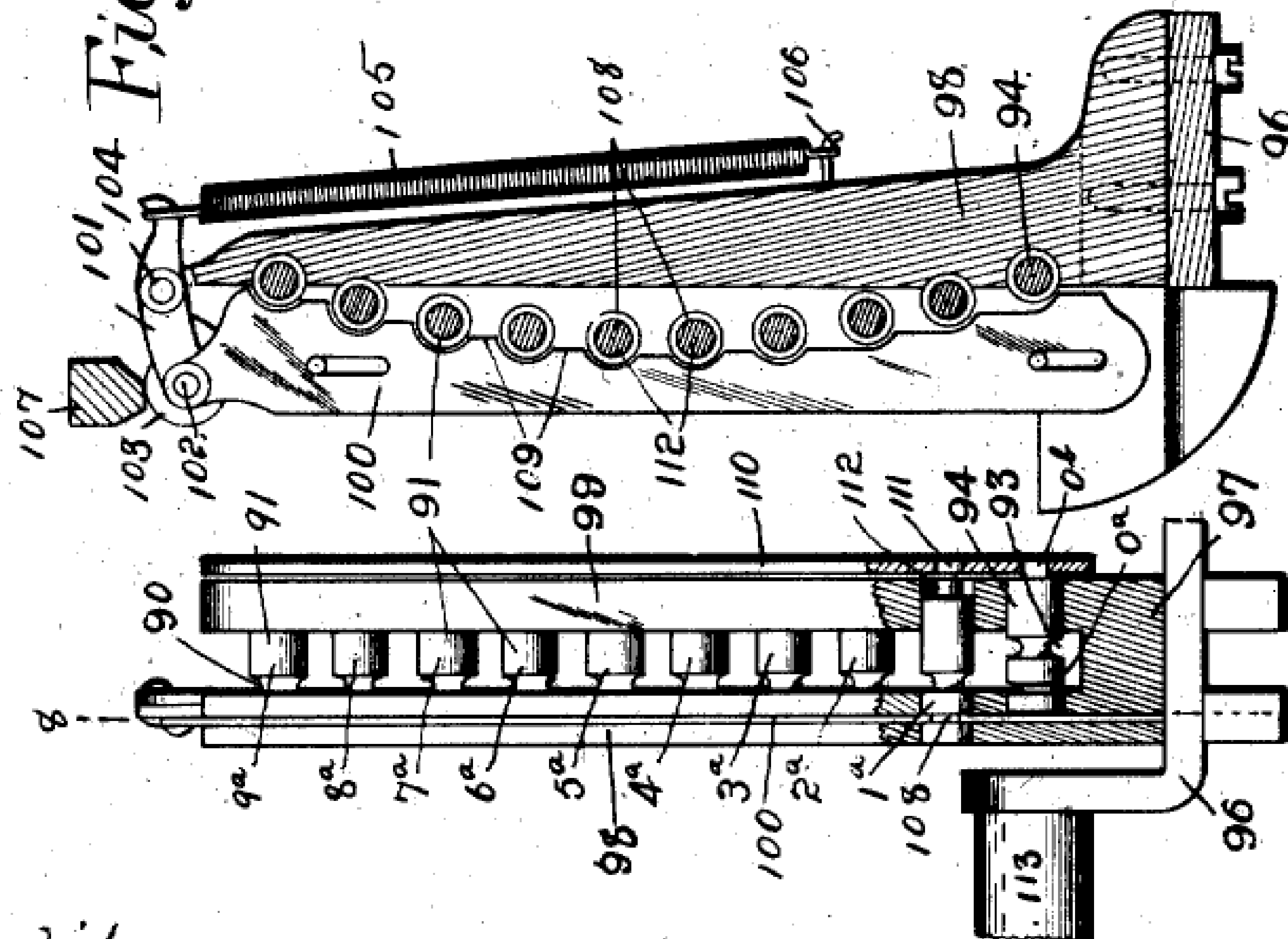
Inventor
Martin Teetor
by Orwig & Lane Attys.

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19 SHEETS—SHEET 6.





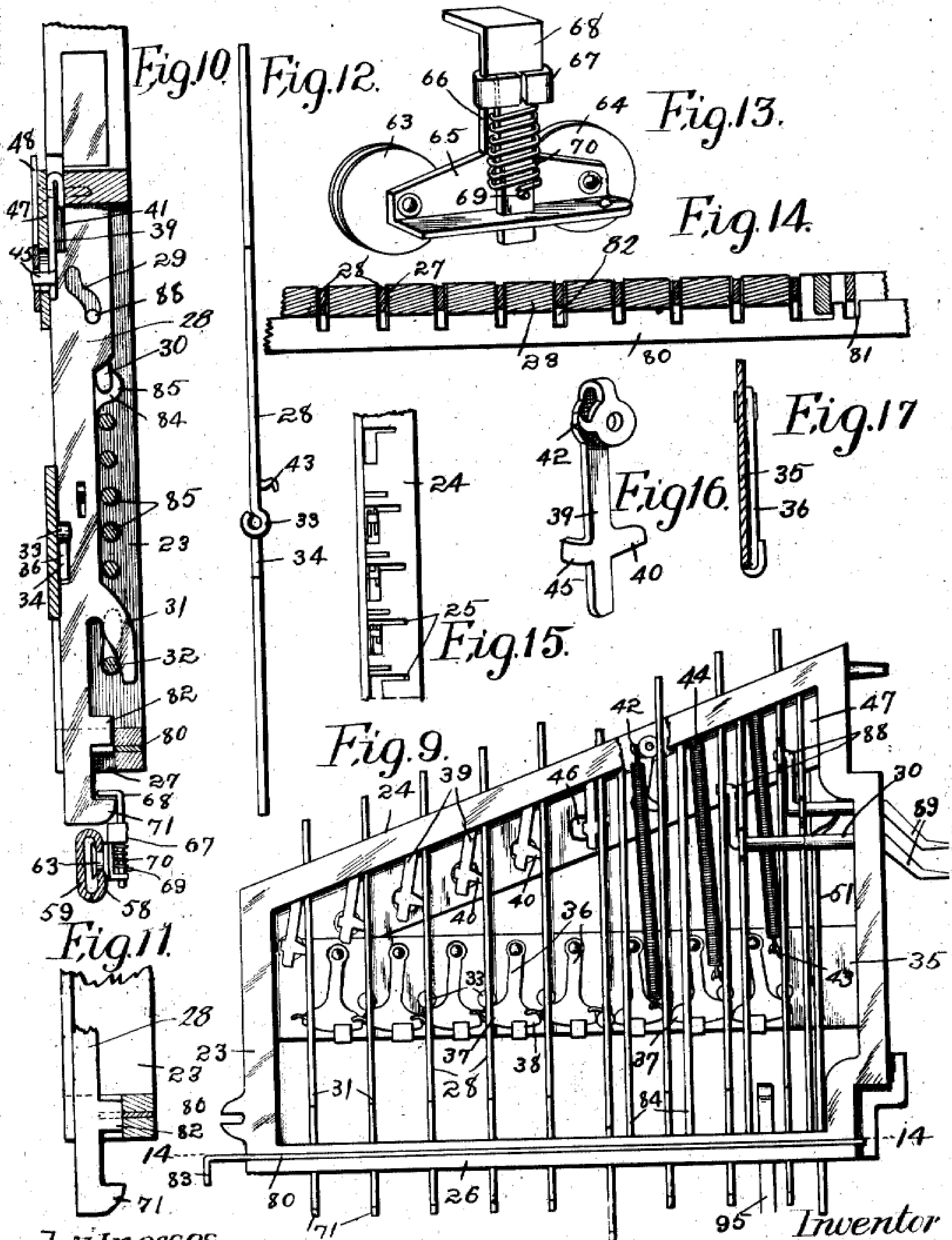
Witnesses.
A. G. Hague.
F. C. Dahlberg.

Inventor
Martin Teetor,
by Orwig & Lane attys

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CALCULATING MACHINE.
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Patented Jan. 8, 1918.
19 SHEETS—SHEET 7.



Witnesses
A. G. Hague.
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane Attys

M. TEETOR.
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APPLICATION FILED APR. 20, 1908.

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Patented Jan. 8, 1918.
19 SHEETS—SHEET 8.

Fig. 20. Fig. 21. Fig. 22. Fig. 23.

Witnesses
A. G. Hague.
F. C. Dahlberg.

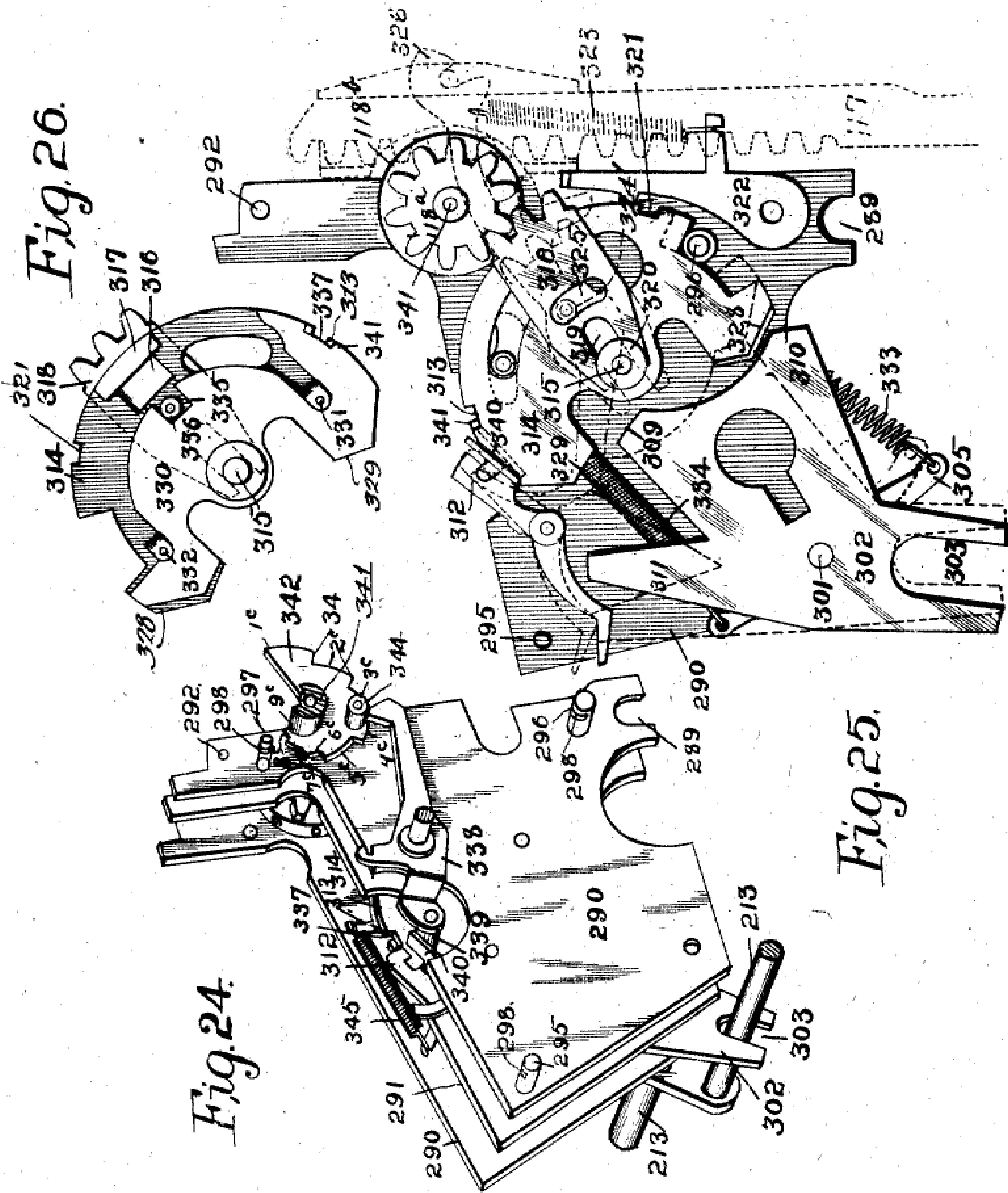
Inventor
Martin Teetor.
by Orwig & Lane Attys.

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M. TEETOR.
CALCULATING MACHINE.
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19 SHEETS—SHEET 9.



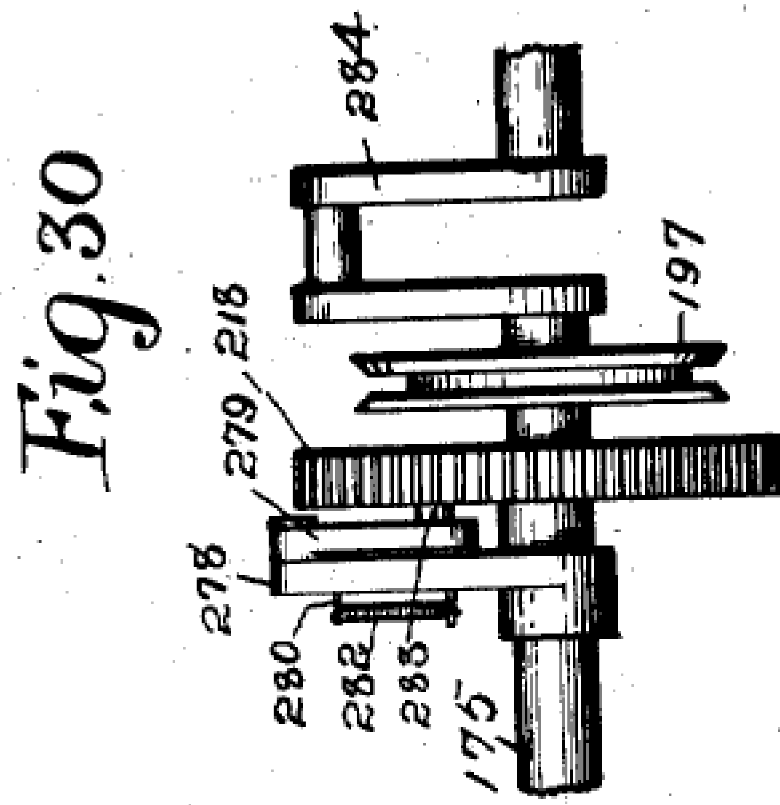
Witnesses
A. G. Hague
F. C. Dahlberg.

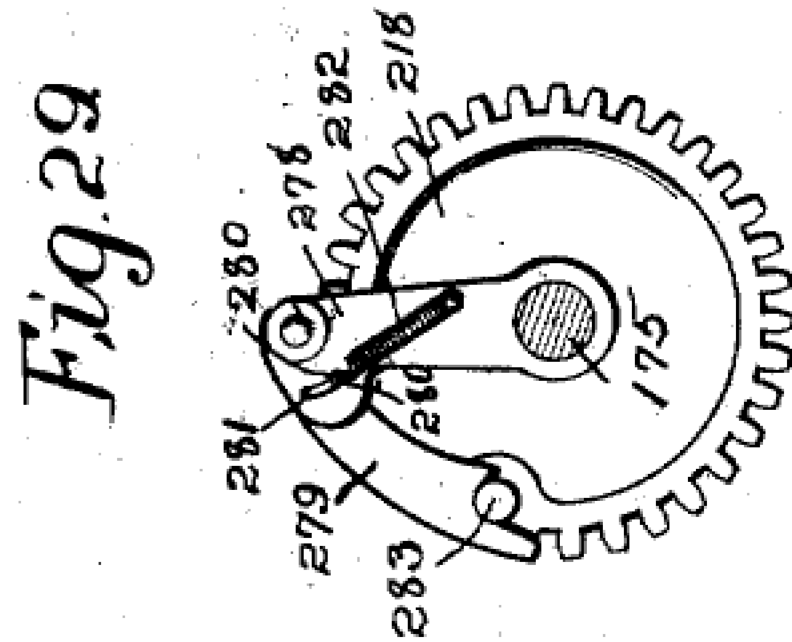
Inventor
Martin Teetor,
by Orwig Lane Attys

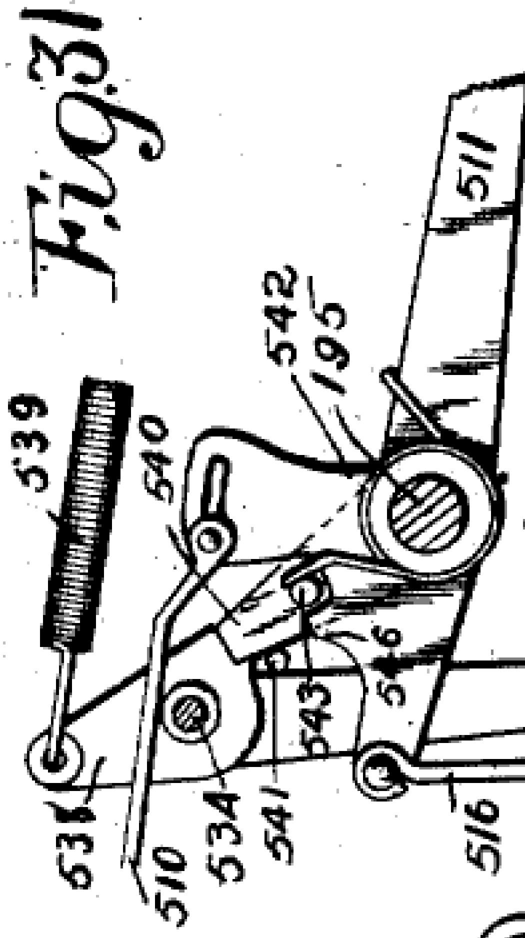
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CALCULATING MACHINE.
APPLICATION FILED APR. 20, 1908.

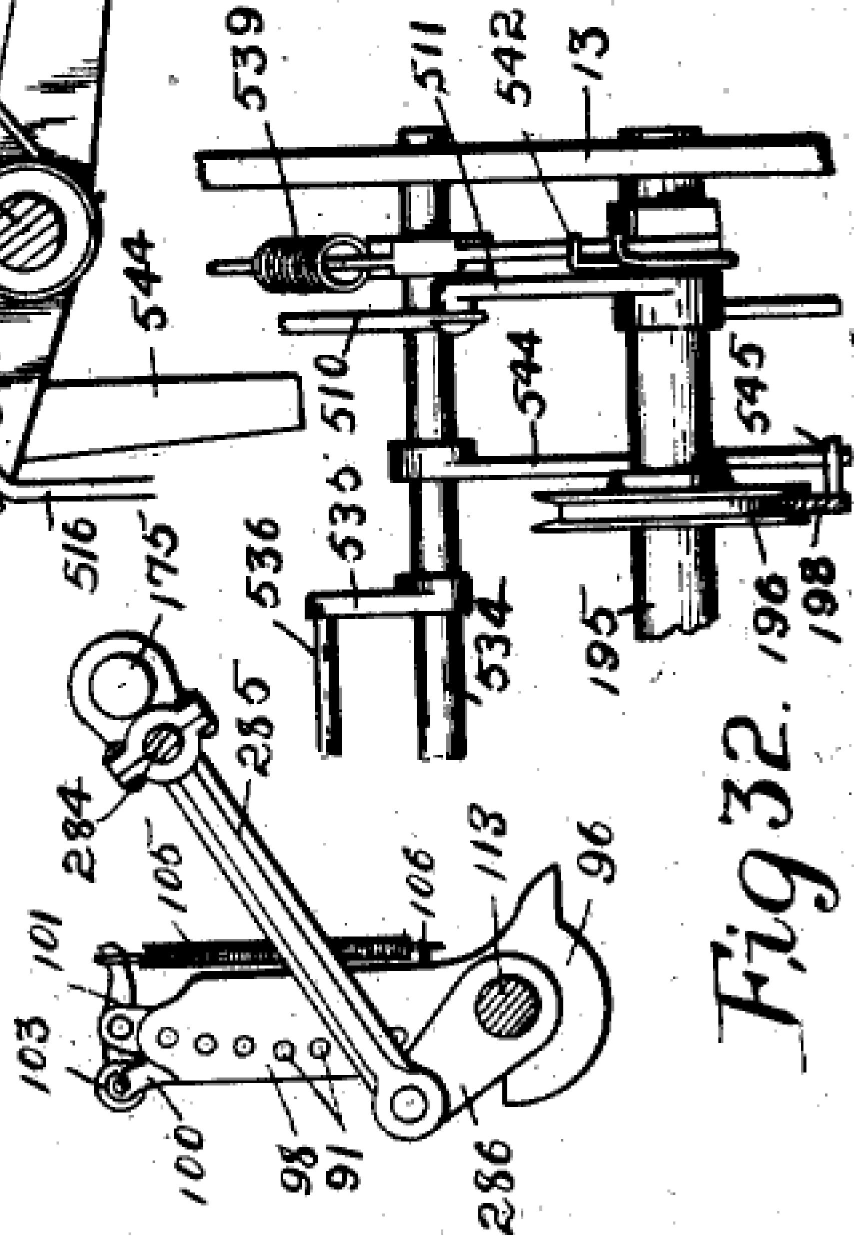
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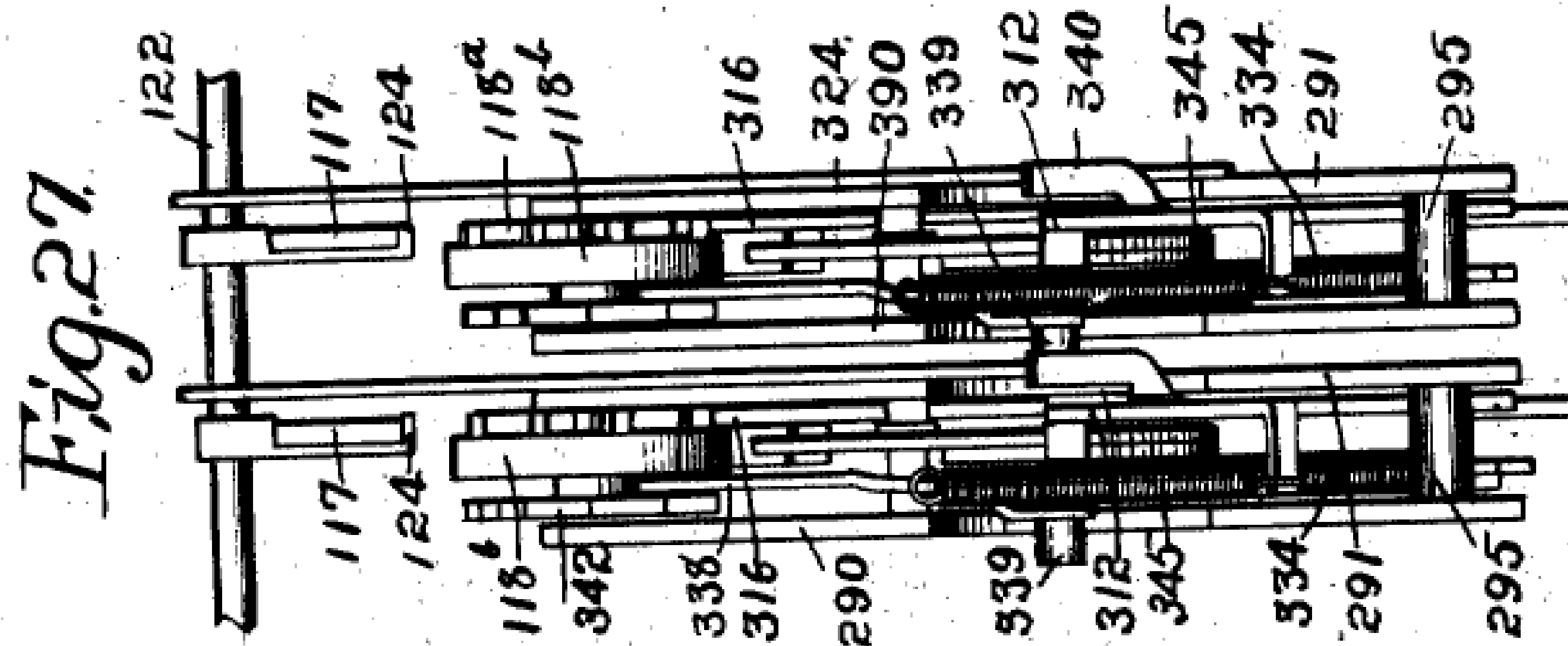
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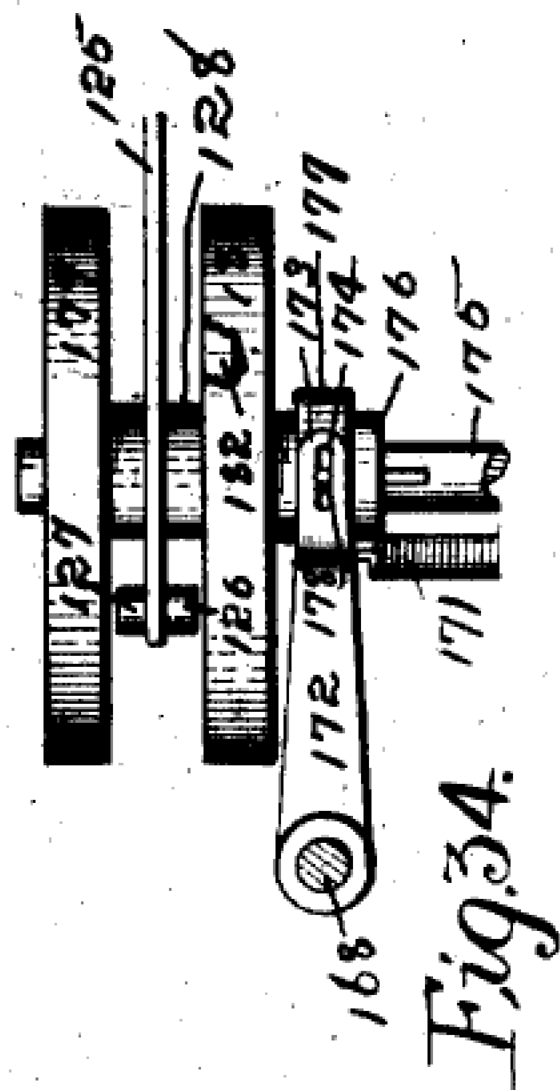
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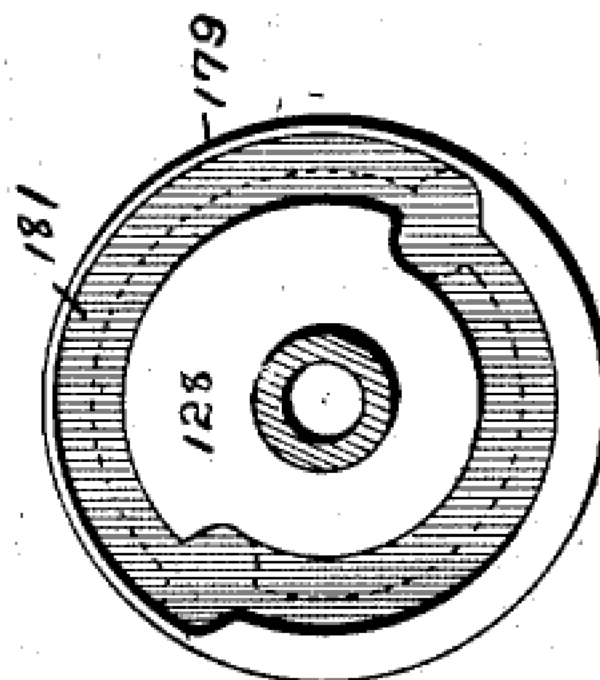
Inventor:
Martin Teetor
by Orwig & Lane Attys

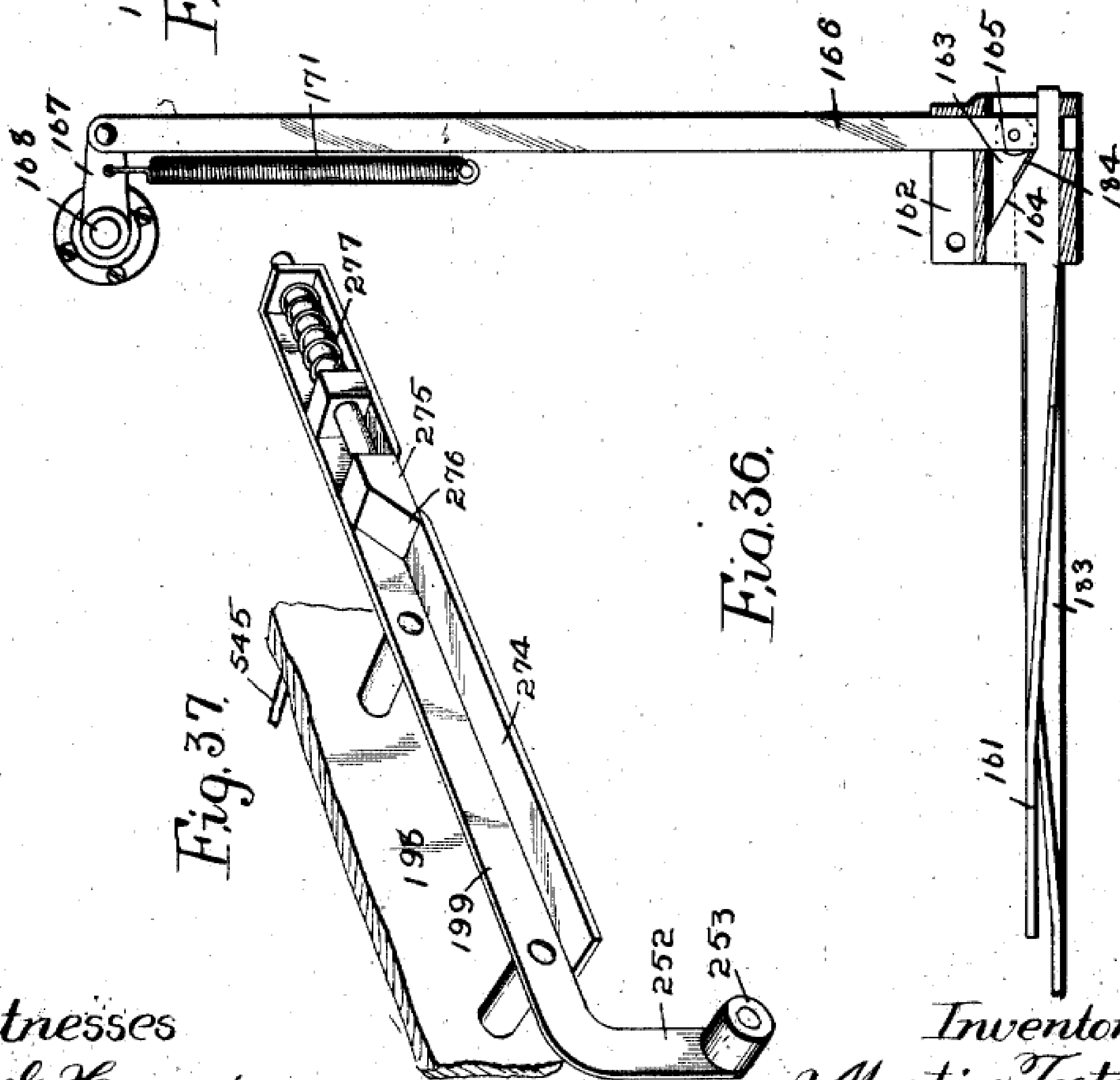
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Witnesses
A. G. Hague.
F. C. Dahlberg.

Inventor
Martin Teetor.
by Orwig & Lane Attys.

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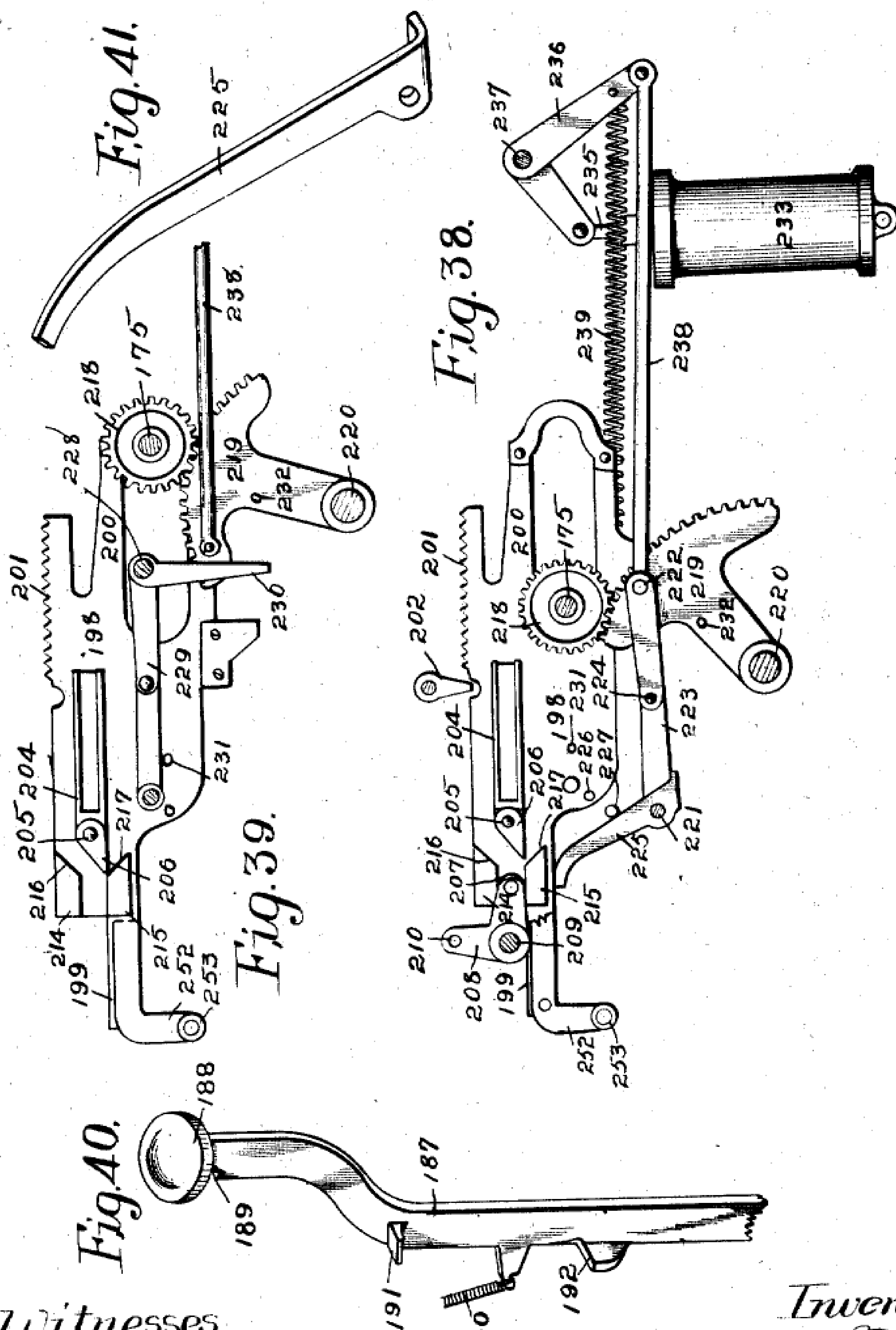
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A. G. Hague

F. C. Dahlberg

Inventor

Martin Teetor.

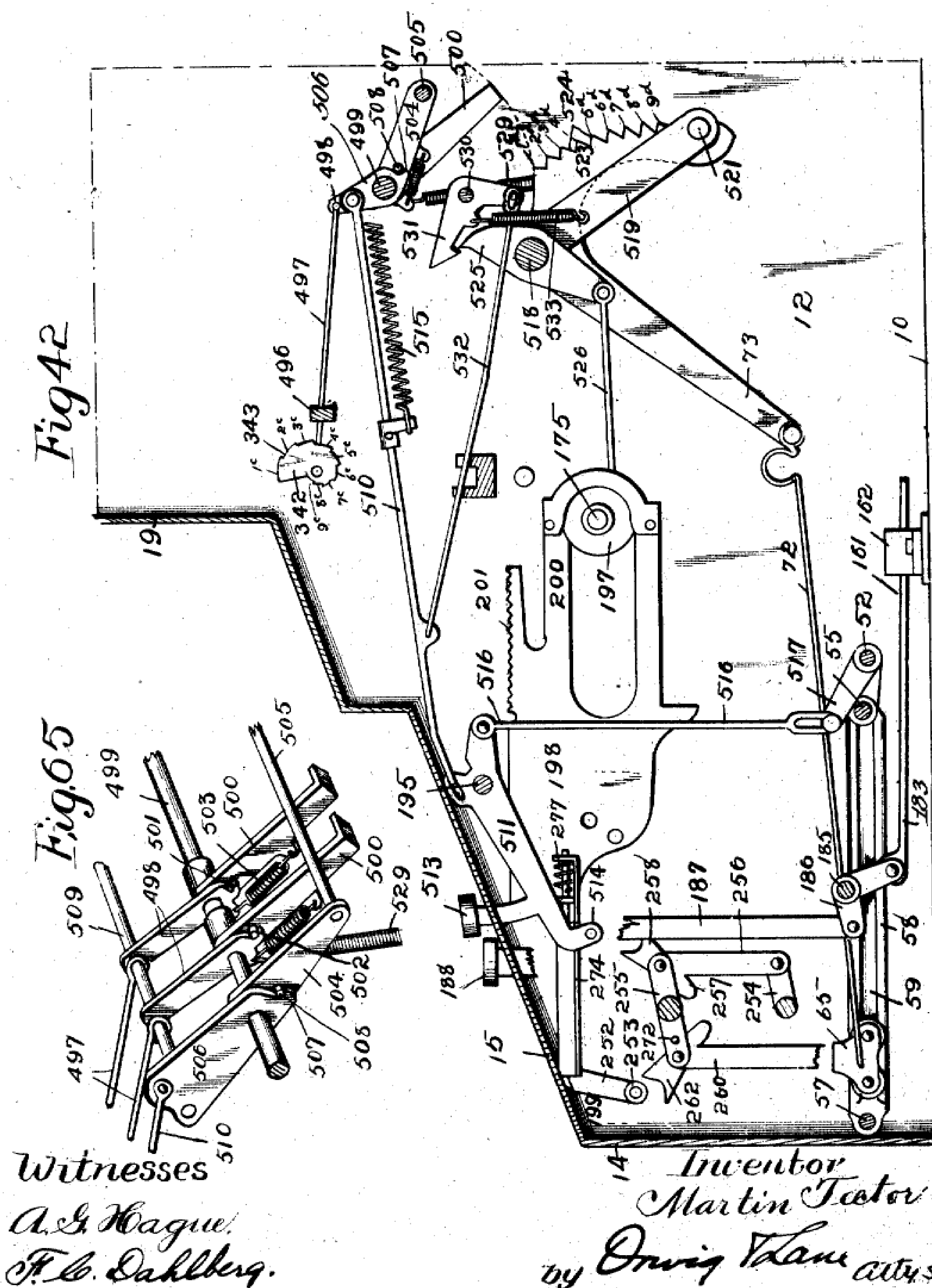
by Orwig & Lane attys

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19 SHEETS—SHEET 13.



Witnesses
A. G. Hague.
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane attys.

M. TEETOR.
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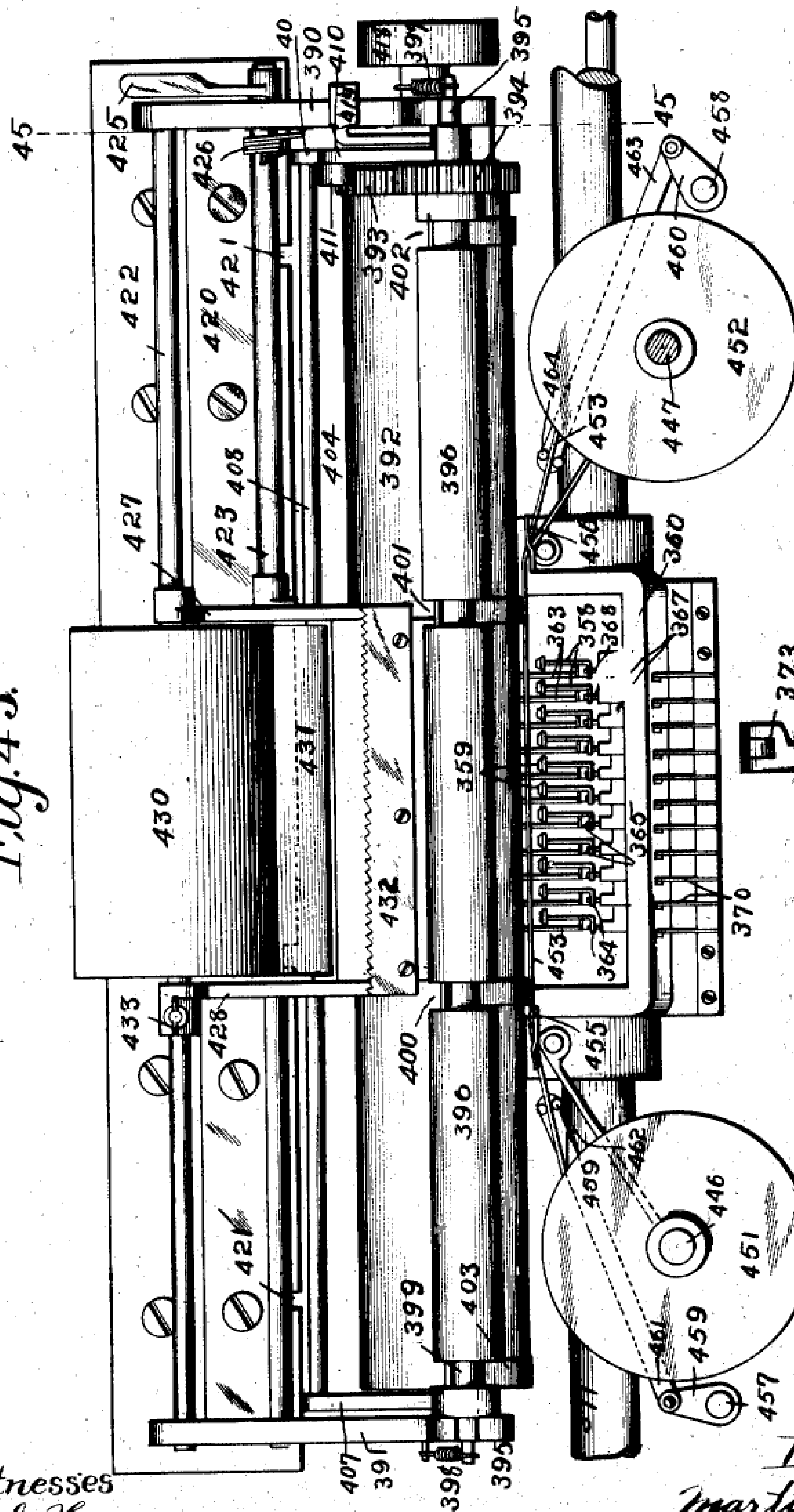


Fig.43.

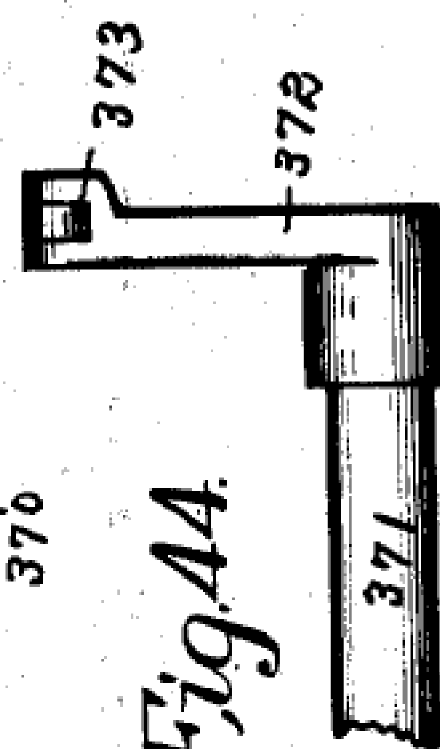


Fig.44.

Witnesses
A. G. Hague
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane Attys

M. TEETOR.

CALCULATING MACHINE.

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Fig. 46.

Fig. 47.

Fig. 45.

Fig. 48.

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A. G. Hague,

F. C. Dahlberg.

Inventor.

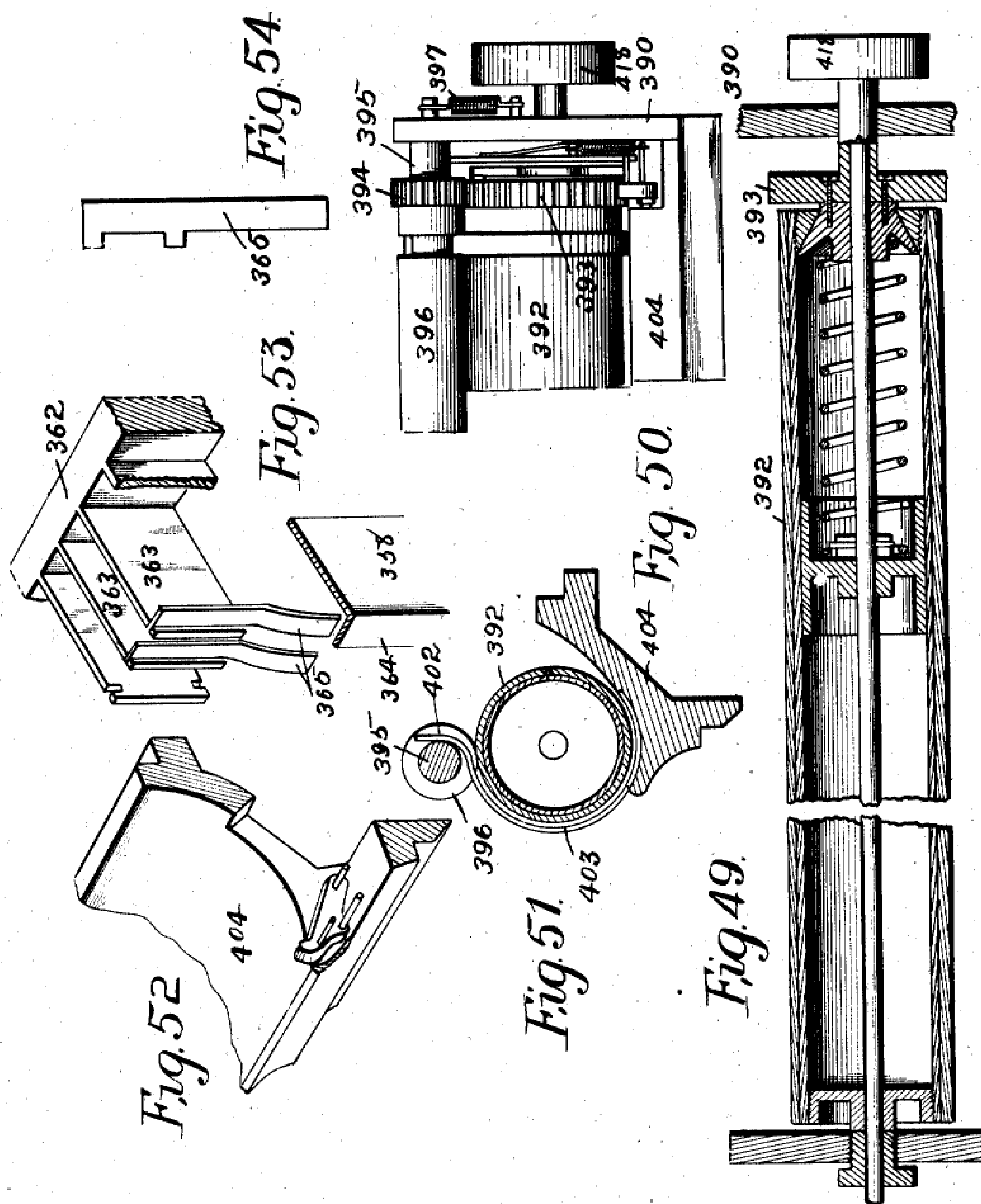
Martin Teetor

by Orwig & Lane Attys

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Witnesses
A. G. Hague
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane Attys

M. TEETOR.
CALCULATING MACHINE.
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Patented Jan. 8, 1918.
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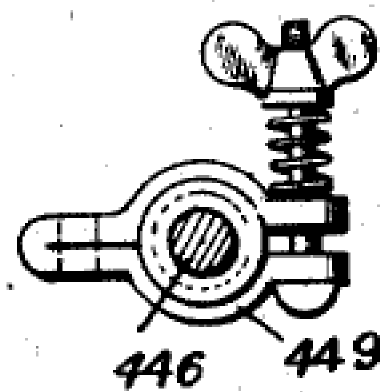


Fig. 61.

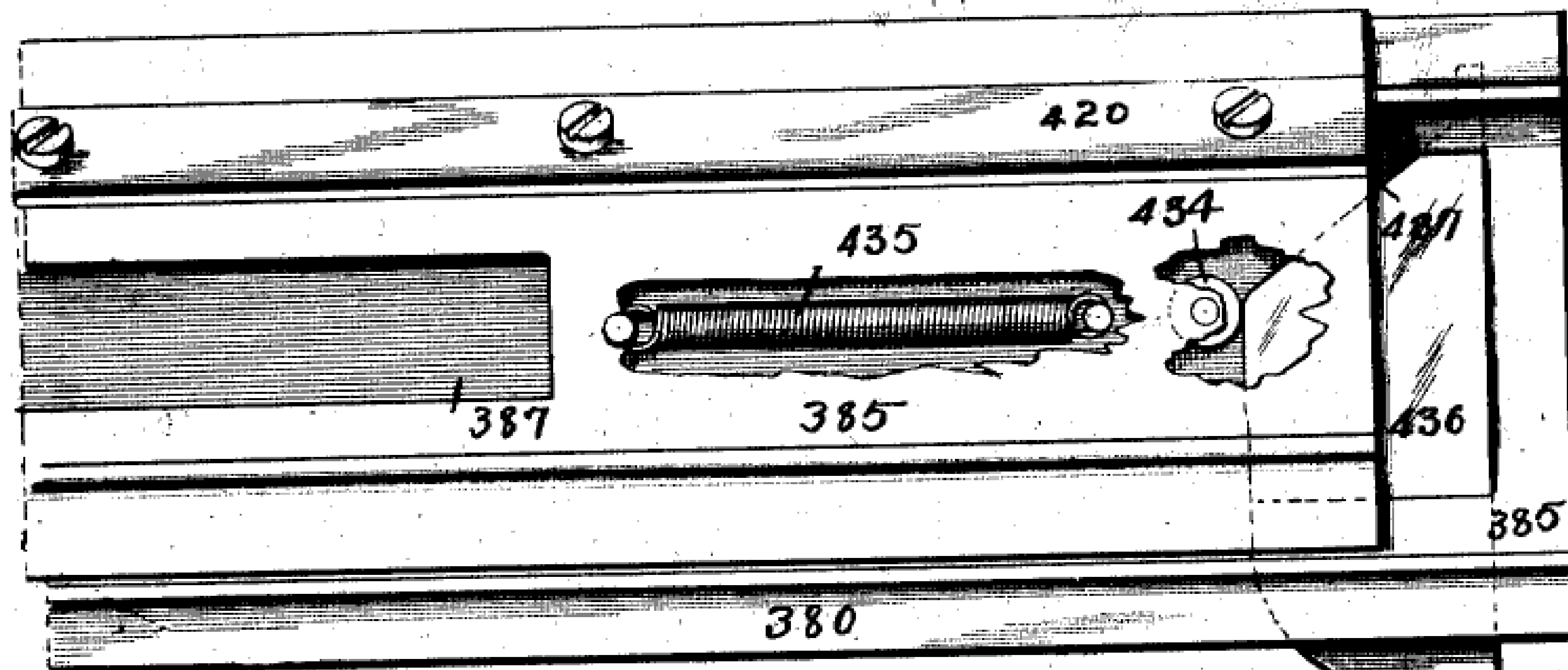


Fig. 55.

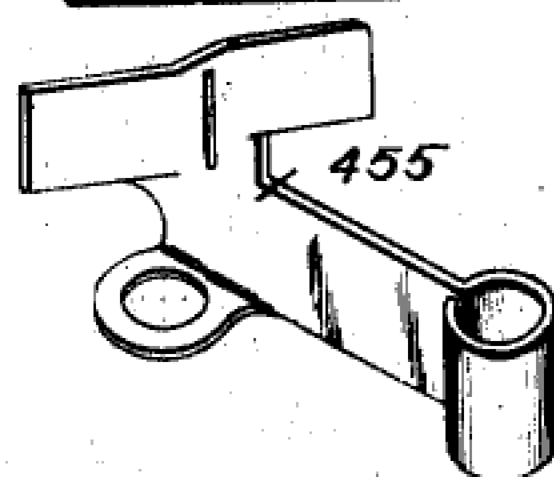


Fig. 60.

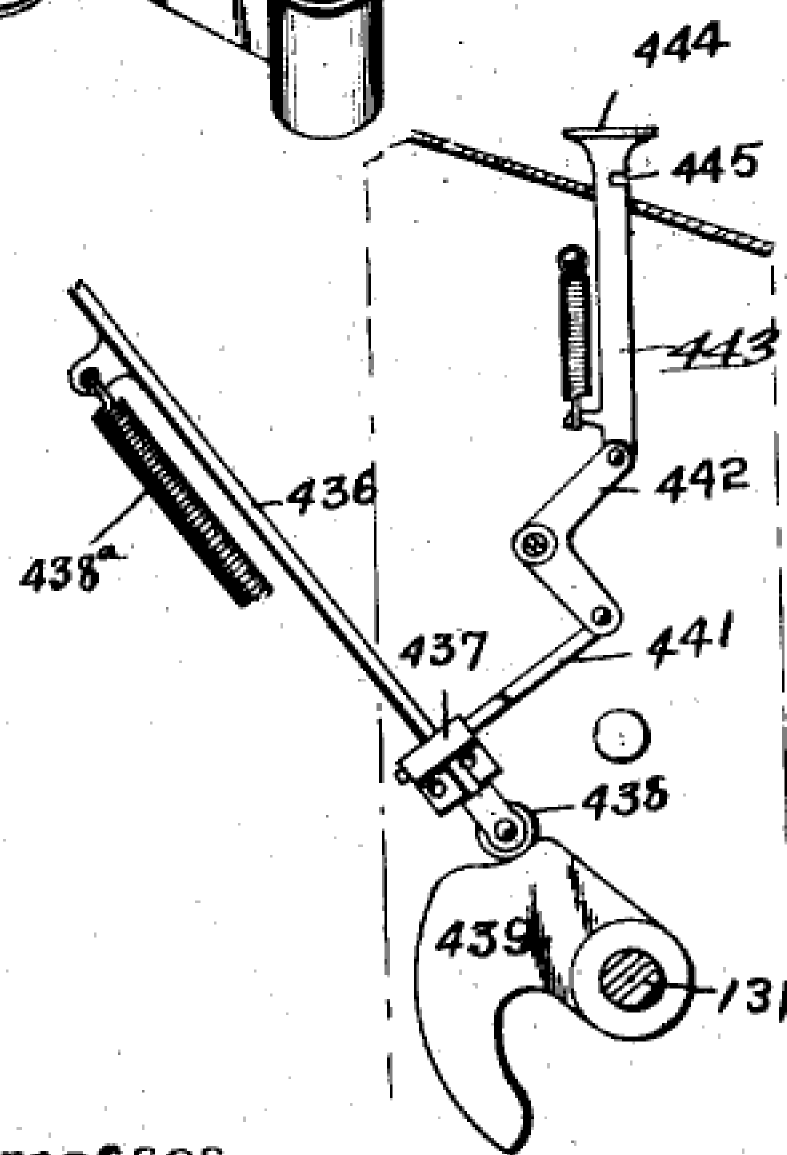


Fig. 57.

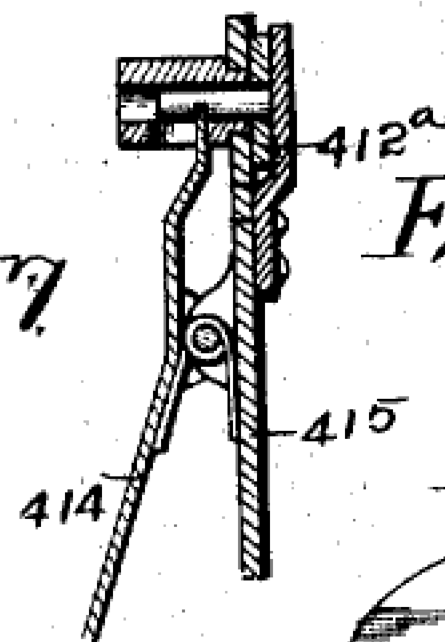


Fig. 58.

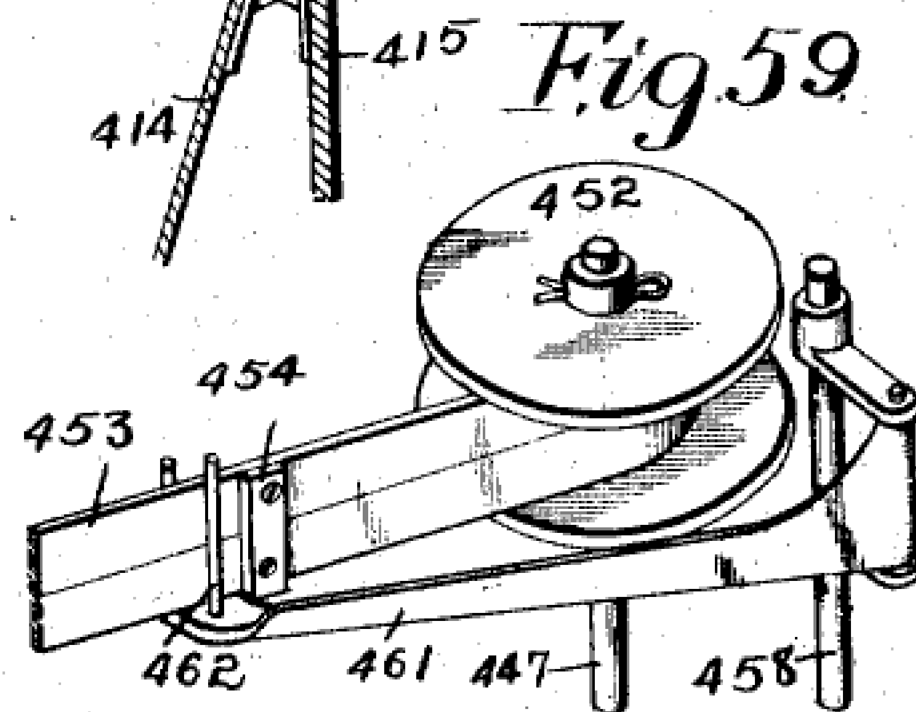


Fig. 59.

Witnesses.
A. G. Hague.
F. C. Dahlberg.

Inventor
Martin Teetor
by Orwig & Lane Attys

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M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 20, 1908.

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Patented Jan. 8, 1918.

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Fig. 62.



Fig. 63.

Fig. 64.

Witnesses

A. G. Hague

F. C. Dahlberg.

Inventor

Martin Teetor

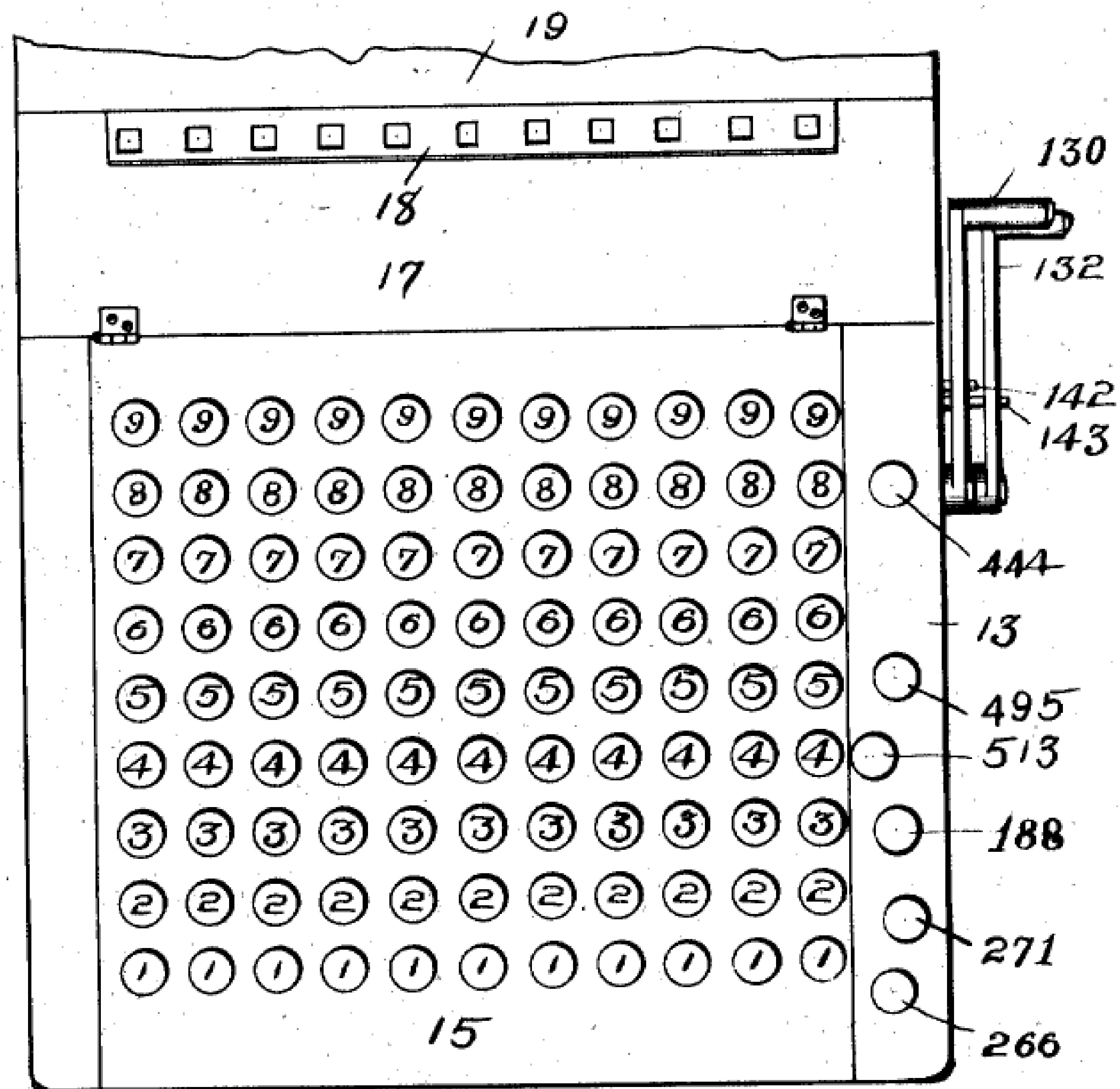
by Orwig & Lane Attys

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APPLICATION FILED APR. 20, 1908.

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Patented Jan. 8, 1918.
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Fig. 66.



Witnesses
A. G. Hague
A. A. Thomas

Inventor
Martin Teetor
by Orwig & Lane attys

UNITED STATES PATENT OFFICE.

MARTIN TEETOR, OF DES MOINES, IOWA, ASSIGNOR TO TEETOR COMPANY, OF DES MOINES, IOWA, A CORPORATION OF IOWA.

CALCULATING-MACHINE.

1,252,738. Specification of Letters Patent. **Patented Jan. 8, 1918.**

Application filed April 20, 1908. Serial No. 427,999.

To all whom it may concern:

Be it known that I, MARTIN TEETOR, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented a certain new and useful Calculating-Machine, of which the following is a specification.

My invention relates more particularly to that class of calculating machines designed to perform the functions of adding, subtracting, and tabulating numbers, in which the scope of the machine is practically unlimited, and in which nearly all of the driving movements of the device are controlled by positive driving mechanisms.

It is my purpose to provide a machine for commercial use comparatively simple, and so constructed that the most complicated parts of the device may be removed in sections so that if one of these sections gets out of order, another one may be readily substituted therefor and the machine kept in use while the part affected is being repaired, and further to control by positive mechanisms the various parts of the device during their operation so that there will be no likelihood of the more delicate parts being broken by the manipulation of the machine.

The objects.

The objects of my invention are to provide a commercial calculating machine having in its construction mechanisms of the simplest character possible, so adapted and arranged as to be automatically operated and controlled through the movement of either the adding or subtracting levers after the keys have thrown these parts into position where the operation desired is attained, and further to so simplify the mechanical construction of this class of machines as to make them more durable, require a minimum amount of adjustment and repair, and render them less liable to get out of order, thereby eliminating, to a large extent, mistakes in their work, and providing for the ready correction of any mistakes that may be made, as well as to keep them out of the repair shop by so arranging the parts that they may be more readily understood by the ordinary user of the machine, thus enabling the machine to stand commercial usage, and at the same time be rapid, accurate and positive in the various movements necessary for adding, subtracting and listing either collectively or separately.

A further object is to provide a series of rows of keys, each row running longitudinally of the machine and arranged parallel with each other for convenience in operation.

A further object is to provide a safety device which will prevent the operation of two keys at the same time in a single row of keys, and will also prevent a second key being set after one key has been set in that row, and thus eliminate complications in the adding mechanisms, thereby obviating errors of the calculating mechanisms as well as the danger of breakage of these parts.

A further object is to provide a mechanism for operating the calculating wheels, which mechanism is driven by pin connections, to provide a positive drive not dependent upon springs.

A further object is to provide a mechanism for positively returning the keys to their normal position, aside from the spring actuated mechanisms which ordinarily return these keys, thus securing a more perfect and positive operation of the parts.

A further object is to provide a single rock shaft upon which all of the pin retaining bars are mounted, and upon which all of these parts are adapted to swing simultaneously as the operating levers are manipulated.

A further object is to provide a safety lock for preventing any of the parts of the machine from being operated if any given key has been accidentally or otherwise moved to a partially set position; that is, if any given key is moved to a partially set position, my safety lock device prevents the adding or subtracting levers, which control the operation of the calculating mechanism, from being manipulated.

A further object is to provide means for regulating the speed of the operative parts of the device, regardless of the rapidity with which the operating levers are manipulated.

A further object is to provide means operated by the totaling button for locking the keys in their upper limits of movement while the totals are being taken and printed.

A further object is to provide a series of

calculating sections in the machine substantially in line with each row of keys, so constructed, arranged and mounted relative to each other that each section may be removed from the machine separately and apart from the other sections, enabling the operator to remove readily and without the use of tools, these calculating sections which form the most delicate portions of the machine, and are the most likely to get out of order, and to substitute for them similar sections and proceed with the use of the machine without material disadvantage, and further to so construct each of these calculating sections that they may be entirely taken apart and disassembled without the removal of any screws or use of any tools.

A further object is to provide means for rotating the calculating wheel in either direction and make possible the operation of adding and subtracting by means of a single mechanism operating on this wheel in both directions, and also to provide a single mechanism for carrying the amounts added to the next column whether added to or subtracted from the amount listed.

A further object is to provide a lever for adding and a second lever for subtracting, which operate through the single mechanism referred to for rotating the calculating wheel in opposite directions, and further to provide a locking device for holding in its normal position the lever which is not being manipulated.

A further object is to provide means for completing the action of each part of the device after each manipulation of the operating levers by providing safety mechanisms which prevent the return of the parts to their normal position until these parts have performed their full function.

A further object is to provide a calculating machine in which the parts are normally held in position for rotating the calculating wheel so that it will add, and further to provide means automatically operated by the subtracting lever for throwing these parts out of their normal position, and allowing the calculating wheel to be rotated in a direction for subtracting.

A further object is to provide a mechanism for holding the rack, which operates the calculating wheel, out of operative relation with this wheel so that it will neither add nor subtract when thus held, and will enable the operator to use the machine as a tabulator.

A further object of my invention is to construct a machine which will both add and subtract, and in which corrections can be made in the work performed by the machine by subtracting the amount accidentally added, and then adding the correct amount afterward, or in the event the machine is subtracting, it will enable the operator to add the amount accidentally subtracted and then subtract the correct amount afterward.

A further object is to provide means in the machine whereby the carrying device is operated from the adding or subtracting levers without the pressure or use of any keys in the key-board, and further a mechanism is provided for returning in a positive manner the carrying mechanisms to a normal position.

A further object is to provide a printing mechanism which is operated through a portion of the same mechanism that performs the adding or subtracting in the device, and which completes its operation simultaneously with the adding and subtracting mechanism. Such printing mechanism is designed to be operated either in connection with or separate from the adding or subtracting mechanism. Furthermore, the printing mechanism is so constructed and arranged that it is adapted, by simply adding parts to it, for use in a machine of any desired capacity or scope.

A further object is to so arrange the mechanisms which operate the carriage of the printing device that this carriage will automatically shift whenever the subtracting lever is manipulated, and cause the amount subtracted to be listed in a column at one side of the column being added, and further to so construct the printing portion of the machine that the numbers being subtracted on account of mistakes or otherwise, may be listed in a different color from the numbers added, and to provide an automatic return of the ribbon when unwound from one of its carrying rollers.

A further object is to provide a total key which automatically sets into operation mechanisms for operating the keys which will cause the printing device to print the correct total of all addition and subtraction operations performed prior to the totaling by the machine upon the operation of the adding lever. When this total has been taken, the machine may be readily cleared of the numbers added or subtracted by the operation of the subtracting lever when the total button is in a set position.

Various other objects are apparent from the construction shown in the drawings, some of which will be specifically set out in the description hereinafter, but these are too numerous to set out specifically under the general heading of objects on account of the complexities of a machine of this class.

General plan of the machine.

My invention relates particularly to a calculating machine which may be varied in construction to accomplish the various objects set out, and numerous others, such

is using various parts of the machine an adding, subtracting, printing, listing and tabulating in all classes of calculating, recording and registering machines. The keyboard of the machine is composed of a series of vertical rows marked with numbers running in consecutive order from 1 to 9, commencing at the lowermost key and ending with the uppermost key in each section. In the particular machine shown in the drawings, there are eleven of these vertical rows of keys, which rows are substantially parallel with each other. The keys of each row control corresponding mechanisms where parts are duplicated throughout the entire operative parts of the machine.

Each key in the key-board operates a pin connecting mechanism which acts upon the parts of a calculating section and causes the calculating wheel of the section, corresponding to that in which the key is found, to be actuated a certain number of points either forwardly or rearwardly if the adding or subtracting lever is operated. This action, however is controlled by speed regulating mechanism which provides for the safety of the operative parts of the device, regardless of the rapidity of the manipulation of the adding and subtracting lever.

There is provided in the machine a carrying mechanism which is operated simultaneously with the operation of the calculating wheel for carrying over during addition and subtraction, as is customary in various adding machines. The operation of each key is protected against accident to the operative parts of the device by safety locking mechanisms which control the action of the keys, and the action of the levers at the proper time, and to insure the machine against damaging results by incompetent handling.

In connection with the various constructions of each section, the simplest mechanisms possible have been used to insure the correct action of the machine, and at the same time provide for the ready repair of any parts which may get out of order.

A printing device is provided which may be used independently from, or simultaneously with the calculating mechanisms by the operation of a single key in the keyboard which is designed to control and lock out of operation this calculating device when the machine is used for printing.

A separate key is provided on the keyboard aside from the one for controlling the printing roller, which effects the listing of the total of the amount added or subtracted into the machine by causing the automatic printing of the total when this key is depressed by the operation of the adding lever.

A key is also provided on the key-board for causing the printing mechanism to print in two colors if desired, and a key is also provided for causing the return of keys which have been depressed if it is desired not to add into the machine numbers which have been indicated by these partially depressed keys. A repeating button is also provided on the key-board for causing the machine to duplicate any number which has just been listed.

The general scope of the machine is to add, subtract and list with the mechanisms of the general scope referred to.

My invention consists in certain details, in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of my calculating machine with the right side removed, and the printing device cut away. The shafts mounted in the right side plate are shown in section.

Fig. 2 is a longitudinal, sectional view of the device with the printing mechanism cut away, taken on the line 2—2 of Fig. 3, looking toward the left side of the machine.

Fig. 3 is an end elevation with the rear end removed, and a portion of the printing device cut away.

Fig. 4 is a sectional view of the device cut on the line 2—2 of Fig. 3, looking toward the right side of the machine.

Fig. 5 is a side elevation of the machine with the top portion cut away to show the printing mechanism, looking at the right side of the machine.

Fig. 6 is a side elevation of one of the key sections, designed to particularly show one of the locking and releasing mechanisms for the key.

Fig. 7 is an end elevation of one of the pin bearing sections with a portion cut away, and shown in section to show the relative portions of the pins in operation.

Fig. 8 is a vertical, sectional view of the device shown in Fig. 7, taken on the line 8—8 of Fig. 7.

Fig. 9 is a side elevation of one of the key sections with some of the shafts removed, and is designed to show the lock out mechanisms for holding one of the keys set and preventing the others from being operated when said key is set.

Fig. 10 is a detail view of one of the key operated bars, showing the manner in which it operates the pin operating shafts, and the operation of a portion of the totaling device.

Fig. 11 is a detail view of the lower end of one of the key operated bars, showing the way of mounting the same.

Fig. 12 is an end elevation of one of the key operated bars.

Fig. 13 is a detail, perspective view of

one of the traveling members for operating one of the key operated bars and taking the total.

Fig. 14 is a sectional view taken on the line 14—14 of Fig. 9.

Fig. 15 is a detail plan view of a portion of the frame in which the upper portion of the key operated bars are mounted.

Fig. 16 is a detail perspective view of one of the catches for holding the key operated bar in a set position.

Fig. 17 is an elevation of one of the key locking dogs, shown clearly in Fig. 9, for maintaining the keys in a normal position after one has been set in any given section.

Fig. 18 is a detail plan view of a portion of one of the supporting bars for the frame of each key section, showing the rod by which these frames are removably attached to the supporting bar.

Fig. 19 is a detail view, showing the returning bar for throwing the zero pin back to normal position, and the lower portion of the frame in which it is mounted.

Fig. 20 is a detail elevation of one of the calculating sections (shown clearly in side elevation in Fig. 2) and the calculating wheel, together with the rack which operates said wheel for adding and subtracting, looking toward the left side of this calculating section, with the parts in a normal position.

Fig. 21 is an elevation of the calculating section with the side removed, looking toward the right side of said section.

Fig. 22 is a detail view of the retaining and carrying rack forming a part of the carrying mechanism.

Fig. 23 is a detail view of a portion of the left side of one of the calculating sections, showing in dotted lines the connecting rod between the calculating mechanism, and the calculating rack, and particularly the way of removing the same.

Fig. 24 is a perspective view of one of the calculating sections and the left side of the section adjacent thereto.

Fig. 25 is a detail view of the interior of one of the calculating sections, looking toward the left side of said section with the parts in operative position. This view is the same as Fig. 20, save that the parts are in an operative position instead of a normal position.

Fig. 26 is a detail view of the plates in which the retaining and carrying rack is mounted, looking toward the right side of the machine and the plates removed from their supports.

Fig. 27 is a plan view of two of the calculating sections, and the corresponding number of calculating racks.

Fig. 28 is a detail elevation of the pin bearing frame, and the main shaft with the crank for connecting the main shaft with the operative parts of the pin bearing frame.

Fig. 29 is a detail sectional view of the main driving shaft with the cog and advancing mechanism connected therewith for driving the shaft.

Fig. 30 is a detail elevation of a portion of the main driving shaft, showing the position of the gear illustrated in Fig. 29, and the crank in the shaft for operating the pin bearing frame.

Fig. 31 is a detail view of the locking mechanism operated through the total key for maintaining the upper portion of the key stems at their upper limits of movement as the totals are being taken.

Fig. 32 is a top view of the mechanism shown in Fig. 31.

Fig. 33 is a side elevation of the master plate, referred to hereinafter.

Fig. 34 shows, in elevation, a portion of the main driving shaft, and the adding and subtracting cam mounted thereon with the parts adjacent thereto for controlling the operation of these cams.

Fig. 35 is a side elevation, looking at the interior of the adding cam.

Fig. 36 is a detail elevation of the mechanism which operates the cam shifting lever, shown in Fig. 34 for operating the subtracting and adding cams.

Fig. 37 is a detail view, showing the mechanism for returning the keys, and a locking mechanism for retaining the totaling button in position for taking the total.

Fig. 38 is a detail elevation of the master-plate, and the mechanism for releasing the dash-pot at the proper time for controlling the action of various parts of the machine.

Fig. 39 is a detail elevation of the master plate showing a locking mechanism for retaining the master-plate in position until the dash-pot has completed a portion of its function.

Fig. 40 is a detail view of the totaling key, showing a portion of the key stem.

Fig. 41 is a perspective view of a releasing lever used for breaking the toggle joint in the controlling mechanism, shown in Fig. 38.

Fig. 42 is a sectional view of the machine, showing a large portion of the total taking mechanism, and a portion of the printing mechanism.

Fig. 43 is a plan view of the carriage and a portion of the printing mechanism.

Fig. 44 is a detail view of the rock arm for pressing the type through the type bars into engagement with the printing roller.

Fig. 45 is a sectional view of the printing carriage and paper holding mechanism, taken on the line 45—45 of Fig. 43.

Fig. 46 is a sectional view of the print-

ing mechanism, showing in end elevation the carriage, and in elevation one of the type bars.

Fig. 47 is a detail view of the pawl and pawl bearing arm for operating the platen.

Fig. 48 is a detail view, showing the mechanism by which the pressure devices for forcing the type into printing position are held out of contact with the zero type in all figures to the left of those being used in totaling, as well as in retaining these zero types in this position and listing.

Fig. 49 is a sectional view of the platen.

Fig. 50 is a detail view of one end of the platen, showing the mechanism by which it is driven.

Fig. 51 is a detail, sectional view of the platen, showing the paper guide adjacent thereto.

Figure 52 is a detail portion of a section of the frame, showing in perspective the dog for holding the platen against rearward movement.

Fig. 53 is a spring supporting frame, the springs in which are designed to retain the type out of engagement with the platen.

Fig. 54 is a detail elevation of one of the springs shown in Fig. 53.

Fig. 55 is a plan view of a portion of the printing frame, showing the cam connection for operating the lower carriage, which carriage is operated from the subtracting lever to enable the amount subtracted to be listed in a separate column.

Fig. 56 (on the same sheet as Fig. 5) shows the lower end of a roller bearing rod which throws the column shifting device for listing the subtracted numbers in a separate column out of operation, and the cam for accomplishing this result.

Fig. 57 is a detail view of the rod referred to in Fig. 56, and shows the key for operating the cam, referred to therein, for shifting the lower end of the roller bearing rod.

Fig. 58 is a detail, sectional view of the locking mechanism by which the stroke of the mechanism advancing the platen may be regulated.

Fig. 59 shows one of the rolls upon which the ribbon is wound, and a portion of the mechanism for reversing the winding of the ribbon upon the roll when it has been unwound.

Fig. 60 is a detail, perspective view of one of the ribbon guides.

Fig. 61 is a detail view of a tension device for regulating the speed of the ribbon roll.

Fig. 62 is a side elevation of a portion of the driving mechanism by which the ribbon rolls are operated.

Fig. 63 is a plan view of the device shown in Fig. 62.

Fig. 64 is a detail view of a portion of one of the driving ratchets which operate the ribbon rolls, showing the way in which these ratchets are secured to the shafts upon which they are mounted.

Fig. 65 is a detail, perspective view of a portion of the total-taking mechanism.

Fig. 66 is a top plan view of the key-board, the section of the machine casing to the rear of the key-board being broken away.

The frame of the machine.

The frame of the machine consists of a bottom portion 10, of a back portion 11, two end portions 12 and 13, a lower front portion 14, and a key plate 15 hinged to the front portion 14 by means of the hinge 16. Hinged to the key plate 15 is the middle front portion 17, having a glass 18 mounted midway between its upper and lower extremities, so that the numerals on the calculating machine may be readily visible from the exterior. The purpose of hinging the middle front portion 17 is to enable this to be swung over, and easy access had to the calculating portion of the machine, to remove it or adjust its parts. I have provided an upper front portion 19 which extends to the top of the machine.

Key controlling mechanism.

The key-board of the machine, mounted in the key-plate, has in it a series of vertical rows of keys, the keys in which range in numerals from 1 to 9, commencing at the bottom. There are in the machine, shown in the drawings, eleven of these rows of keys. The action of each key in a given row of keys on the parts which it controls is similar to the action of the same key in any other of the rows, and for that reason a description of one of the rows of keys makes a description of the series of rows individually unnecessary.

The corresponding parts operated by these keys in each row are similar to the parts thus operated by similar keys in any of the other rows, and the action of the subtracting and adding levers is the same on these parts in all of the rows, as well as the action of the other parts of the machine; so that save for the parts of the machine which are not duplicated, a description of one of the series of parts applies to all equally well.

The keys referred to in any given section, as shown clearly in Fig. 2, I have numbered consecutively from the lowermost one to the uppermost one with the figures 1, 2, 3, 4, 5, 6, 7, 8 and 9. These keys are preferably indicated on their upper faces by numbers corresponding to the numbers by which they are referred to herein.

Rigidly secured to these keys and extending downwardly from each of them is a key stem, each of which has a projection 20

thereon. This projection is designed to be engaged by a member, hereinafter mentioned, for retaining the keys at their upper limits of movement during the taking of totals.

Mounted immediately beneath the key-plate 15 is an auxiliary key guide 21 with openings extending through it in line with similar openings in the key-plate 15. This key-plate and key guide are designed to maintain the key stems in a vertical position throughout their movement.

Slidingly mounted on the key guide, and adjacent to the series of key stems is a locking plate 22, having shoulders formed therein for limiting the downward movement of the keys when in engagement with the projections 20, and so constructed that when the keys are at their upper limits of movement, and the slide is operated in the manner hereinafter stated, by the totaling button, the keys will be retained at their upper limits of movement. This locking plate is best shown in Figs. 2 and 6 of the drawings.

Detachably mounted in the machine beneath the key guide 21 is a supporting frame 23, having its upper portion substantially parallel with the key-plate and its lower portion parallel with the bottom 10. The lower front corner of the key-frame is supported by bars which are set in notches 23′ in a bar 23^2 attached to the front of the machine. The key-frame is held in place by rod 23^3 (see Fig. 18).

In the top portion 24 of this key frame there is a series of slots 25 as shown in Fig. 15, and in the bottom portion 26 of the frame 23 is a series of slots 27, as shown in Fig. 14. Parallel with each other, and mounted in the slots of the upper and lower portion of the frame 23 is a series of key operated bars 28, the upper ends of which are designed to engage the lower ends of the key stems of the keys 1 to 9. In other words, the lower ends of the key stems rest on top of the bars 28, whereby the bars are free to move downwardly, independently of the key stem, and yet will be depressed by each of the key stems as the keys are moved downwardly, if the bars 28 are at their upper limits of movement.

As seen in Fig. 10, each of the keys operated bars 28 has in it a curved cam groove 29 for actuating the pin operating crank shafts 30, hereinafter referred to. I have provided a cam projection 31, designed to engage the crank shaft 32 for withdrawing the zero pin simultaneously with the setting of another pin by means of the crank shaft 30. On the opposite side of each of the bars 28 from that upon which the cam projection 31 is formed, I have provided a projection 33 formed by curling up a portion of the side of the metal in the bar 28, and forming an opening 34 in said metal, as shown in Figs. 10 and 11.

Extending transversely of each frame 23 is a brace 35 connecting the front and rear ends of this frame. Pivotally attached to one side of the brace 35 and between the key operated bars 28 is a series of lock dogs 36 (see Fig. 9), on the lower end of each of which there are two projections 37 and 38, designed to be substantially in line with the openings 34 in the key operated bar 28 (see Fig. 10). When one of the keys is depressed, the corresponding bar will be pushed downwardly, and cause the projection 33 to engage the projections 37 and 38 on the locking dogs 36, and force these apart, causing the projections on the dogs to the right and left of the bar 28, which has thus been depressed, to simultaneously enter the opening 34 and retain these bars 28 in a locked position, thus preventing the keys from being operated, after one key has been partially or fully depressed. This will be seen by examining Fig. 9, where the key 6 has been depressed, the other keys being locked by this means at their upper limits of movement.

Pivoted to the upper portion 24 of the frame 23 is a series of key retaining catches 39 which are between the series of bars 28, and adjacent thereto (see Figs. 9 and 16). Near the lower portion of these key holding catches is a lug 40 designed to engage the side of the bar 28 adjacent to it, when the key is in its normal position, and so arranged that each will engage the shoulders 41 in the bar 28 adjacent to it when depressed, for retaining the bar at its lower limit of movement, and prevent the key from being returned until this key retaining catch is released. These catches 39 have a hook 42 secured near their pivotal point of attachment, as shown clearly in Figs. 9 and 16. There is a similar hook 43 on each of the bars 28.

Connecting the hooks 42 and 43 is a spring 44 designed to serve the double purpose of normally retaining the bars and keys at their upper limits of movement as well as to draw the key retaining catches into their locking position when the keys are depressed, as shown clearly in Fig. 9.

On the rear side of each of the catches 39 is a lug 45, which extends through openings 46 in the brace 47 near the top of each frame 23. These lugs are designed to be engaged by a slidably mounted catch releasing member 48 (shown in Fig. 6) which is on the opposite side of the brace 47 from the catches 39. There is a pin 49 in the rear end of the catch releasing member 48 which enters a cam groove 50 in a vertically mounted operating bar 51 which is moved upwardly by the positive mechanism to be

hereinafter described, for returning the bars 28, and with them the keys of the machine to their normal position, and supplement the action of the springs 44.

Extending transversely of the lower portion of the machine (see Fig. 3) is a rock shaft 52 having connected with it, by means of two rock arms 53 and 54, a swinging shaft 55. Extending transversely of the machine, pivotally mounted in the sides thereof, and near the front end of it, is a crank shaft 56, the crank portion of which I have numbered 57, as shown in Figs. 1 and 2.

Pivotally attached to the crank 57 and the shaft 55 is a series of longitudinal bars 58, having a channel 59 in each of them. The rock shaft 52 is operatively connected with other parts of the machine which are connected with the operating lever and is actuated by it to swing the bar 58 upwardly by means of the arms 53, and the crank shaft 57 in such a way that the upper surface of this bar 58 engages the lower extremities of the operating bars 51, and moves them upwardly, whereupon the catches 39, which hold the bars 28 downwardly, are released and these bars and the catches 39 returned to their normal position by the springs 44. If, however, any of these springs 44 fail to act, the upper portions of the bars 58 engage the lower portions of the bars 28 and return the keys to their normal position by positive action. In order to have both ends of the bar 58 work simultaneously, I have provided an arm 60 on the rock shaft 52, and an arm 61 on the shaft 56, each of which is pivotally attached to a connecting rod 62, as shown in Fig. 2. Thus it will be seen that as the rock shaft 56 is operated, the rock shaft 52 will be simultaneously operated with it for raising and lowering the bar 58.

Mounted between the pieces of metal on the bar 58, which forms the channel 59, are the grooved rollers 63 and 64 connected with each other by a carriage 65, having an upright 66 thereon extending upwardly from its central portion. The upper end of this upright 66 is bent into the form of a loop 67 to receive the vertically movable hook 68, as best shown in Fig. 13.

There is an opening extending through the carriage 65 for receiving the lower end of the body of the hook, so as to maintain it in its vertical movement. There is a limiting stop 69 in the body of the hook, designed to be engaged by a spring 70 which passes around the body of the hook, and engages the loop 67 for normally maintaining this hook at its lower limit of movement for exerting a yielding pressure on the hook, and allowing it to engage a hooked portion 71 on the lower end of each of the key operated bars 28, even though these bars may be out of line somewhat. This carriage and its parts are well illustrated in Figs. 2 and 13, and the whole mechanism is termed a traveling carriage for the sake of convenience.

This traveling carriage is designed to be operated through a rod 72 which is pivotally connected with it, and with an operating lever 73 in the totaling mechanism. It will, of course, be understood that there is a traveling carriage for each row of keys. These traveling carriages are so constructed and arranged that when the total button is depressed they will be moved adjacent to the key operated bars 28 which represent the parts corresponding with the total calculated into the machine by its previous operations. The hooks 68 of each traveling carriage will engage the hook 71 of the associated bars 28, and upon the operation of the adding lever, with the totaling button depressed, these traveling carriages will draw the bars 28 downwardly and automatically set them to correspond to the numbers in the total in the machine, thereby causing the total to be printed by the printing mechanism.

Extending transversely of the lower portion of the machine is a shaft 74 having an arm 75 at each end thereof, between which arms there is a slotted bar 76, as shown in Fig. 4. The shaft 74 has mounted on it an arm 77, to which is pivotally attached the rod 78, connected with a pivotally mounted locking lever 79, hereinafter referred to in connection with the other operations of the device.

Slidably mounted in the lower portion of each frame 23 is a safety lock bar 80 (see Figs. 9, 10, 11 and 14), having a series of slots 81 in one edge of it, so arranged that the projection 82 on the key operated bar 28 is allowed to move vertically through these slots in the ordinary operation of the machine, and the safety lock bars 80 are allowed to move horizontally above and below said projection when the keys are not depressed at all, or are fully depressed. When, however, one of these key operated bars 28 has been partially depressed and is in that position, the machine is locked out of operation, owing to the fact that the metal at the side of one of the slots 81 in the safety lock bar 80 engages the projection 82. This action is brought about by the operation of the shaft 74, as there is a hook 83 on the forward end of the bar 80, which enters the slot in the slotted member 76, causing the bar 80 to follow the movement of said slotted bar 76 when not in engagement with the projection 82.

The use of these safety locks and locking mechanisms for the key operated bars referred to obviates, to a large extent, the danger of the machine getting out of repair and mistakes being made in the operation through use by an inexperienced operator.

Extending vertically of each frame 23 is a series of bearing bars 84 parallel with each other, and adjacent to each key operated bar 28, as shown in Figs. 2, 6, 9 and 10. In each of the bars 84 there is a bearing 85, and extending through the back portion of the supporting frame 23 is a series of bearings 86. Each of the bearings 86 is in line with a bearing 85 in the bars 84.

Mounted in the bearings 85 and 86 is a series of pin operating crank shafts 30, hereinbefore referred to, and shown clearly in Fig. 2, each having a crank 88 on its forward end, which crank enters the cam grooves 29 (see Fig. 10) in the key operated bar 28, so that as the keys are depressed, the crank shafts 30 will be rocked slightly. On the rear end of each of these crank shafts 30 I have provided a pin operating member 89, shown clearly in Figs. 2 and 9, designed to enter an annular groove 90 (see Fig. 7) in the pins 91 of the pin controlled mechanism for setting and withdrawing these pins.

Beneath the series of crank shafts 30 is the crank shaft 32, referred to heretofore, one of which is mounted in and extends longitudinally of each frame 23. The bearings of this shaft are in the rear and forward end portions of the frame 23. This is shown clearly in Fig. 2. This crank shaft 32 has a pin operating member 92 designed to engage an annular groove 93 (see Fig. 7) in the zero pin 94 for withdrawing this zero pin as one of the other pins is set, and for setting this pin, as one of said pins 91 is withdrawn. This crank shaft and its pin operating member 92 are operated simultaneously with the depression of any key, owing to the fact that the cam projection 31 on the key operated bar 28, engages this crank shaft as said bar is moved downwardly. Each of the crank shafts 32 is returned to its upward or normal limit of movement by means of an operating bar 95 pivotally attached to the bar 58, as this bar is operated, (shown in Figs. 2 and 19.)

Extending transversely of the machine and rotatably mounted in the sides 12 and 13 is a rock shaft 96, (shown in Figs. 3, 7 and 8,) having a series of pronged pin bearing frames 97 in the prongs 98 and 99, of which the series of pins 91 are slidably mounted, and the channels 90 in these pins are between the prongs, so that they may be engaged by the pin operating members 89 on the rear end of each of the crank shafts 30.

Slidably mounted in the prong 98 is a pin locking member 100, having a series of notches in its edge, as clearly shown in Fig. 8. To the upper end of this member the lever 101 is connected by means of the pivot 102 which bears a roller 103. The lever 101 is connected to the upper end of the prong 98 by means of the pin 104. The end of the lever 101 opposite from that to which the roller 103 is secured, has, attached to it, a spring 105, the lower end of which spring is secured to the prong 98 by means of a hook 106. There is a releasing bar 107 extending across the machine and mounted in the sides of it, which engages the roller 103 and normally holds it, together with the locking bar 100, at its lower limit of movement, leaving the pins 91 in position for being operated. In that portion of each pin which is in the prong 98 I have provided an annular groove 108 designed to come in line with the pin locking member 100 when the pins are in their normal position, as shown in Figs. 7 and 8.

When the pin bearing frame is swung by the rock shaft 96, the roller 103 is drawn out of engagement with the releasing pin 107, and the spring 105 allowed to act to raise the pin locking member 100 and retain the pins in the positions in which they have been set prior to the rocking of the crank shaft 96, by the projections 109 entering the grooves 108 in the pins which have not been moved, and passing behind the pins which are set by the operation of the key. In order to make the foregoing clear, I have given an additional number to the pins to show their relation to keys above referred to. The lowermost pin I have numbered 0^a, and the pins above it in consecutive order from the lowermost 1^a, 2^a, 3^a, 4^a, 5^a, 6^a, 7^a, 8^a, and 9^a. From this numbering and lettering, it will be observed that the keys which operate the pins bear each a number corresponding to that representing the corresponding pin.

Mounted on the outside of the prong 99 of each of the pin bearing frames 97, and having its outer surface in engagement with the prong 98 of the next adjacent pin bearing frame, by which it is held against lateral movement, is a pin controlled swinging member 110 having a series of openings 111 in it which, for the sake of convenience, I have additionally indicated in consecutive order from the bottom 0^b, 1^b, 2^b, 3^b, 4^b, 5^b, 6^b, 7^b, 8^b, and 9^b, to show that the pins corresponding in numbers enter these openings when they are operated by the proper keys. There is a small end 112 on each pin (see Fig. 7) designed to enter the openings 111 while the larger portions of the pin engage the inner surface of the swinging member 110 and prevent further movement of the pin.

The zero pin 94 is in line with the center of the bearing 113 of the rock shaft 96, so that whenever the pin bearing frame is operated, and the zero pin 94 is in the opening 0^b, there will be no swinging movement of the plate 110, the sole purpose of the zero pin being to normally hold the swinging

member 110 in position relative to the pin bearing frame 97 when none of the other pins have been set.

Each of the pin controlled swinging members 110 has an outwardly extending arm 114 which is pivotally attached at its outer end to the lower arm of the bell crank lever 115, mounted on a bearing shaft 116, as shown in Fig. 2. The upper arm of the bell crank lever 115 is pivotally connected with a calculating rack bar 117, the teeth in which are so spaced apart as to mesh with a calculating wheel 118 (see Figs. 2, 20 and 27) having ten teeth in its periphery, and as the rack is elevated the distance of one tooth, the wheel will be rotated one-tenth of one complete revolution, and a corresponding distance for each additional raising of the rack.

In order to understand thoroughly the operation of these parts, I have used the following illustration. Assuming that the key 9 is depressed, and with it the key operated bar 28 immediately beneath it, the cam 29 will cause the associated crank shaft to be rotated slightly, and the pin 9^a will be forced by the pin operating member 89, which enters the channel 90, into the opening 9^b in the pin controlling swinging member 110, at the same time the cam projection 31 on the key operated bar 28 will engage the rock shaft 32 and cause the pin operating member 92 on said rock shaft to withdraw the zero pin 94 from its normal position in the opening 0^b in the pin controlled swinging member 110. When this key 9 is at the lower limit of movement and the pin 9^a is set and the zero pin withdrawn, as indicated, the key operated bar is retained at its lower limit of movement by the retaining catch 39, and the other keys are held out of operation by the key locking dogs 36. The operating lever, hereinafter referred to, is then operated to swing the crank shaft 96 and, simultaneously therewith the pin carrying frame 97 and the pin controlled swinging member 110, which latter member swings on the pin 9^a as a pivot, as shown in Fig. 1, to draw downwardly the calculating rack 117 for advancing the calculating wheel nine points. Thus the amount indicated on the key is transferred to the calculating wheel. When the operation is completed, the pin carrying mechanism is returned to its normal position through the parts hereinafter described.

Extending transversely of the machine and above the upper arm of the bell crank lever 115 is a shaft 119, adjacent to the ends of which I have mounted the arms 120 and 121, between the free ends of which there is mounted the shaft 122, as shown in Figs. 1 and 2. Pivotally mounted on the shaft 122, between the arms 120 and 121 is a series of pivotally mounted guide plates 123, each of which has a slotted member 124 (see Figs. 20 and 23) at its upper end through which one of the rack bars 117 passes; that is, there is one of these pivotally mounted guides for each of the rack bars 117, and as the shaft 119 is rocked, the rack bars are moved into or out of mesh with the adjacent calculating wheel 118.

Secured to the shaft 119 is an operating arm 125 (see Fig. 3) which has on its free end two rollers 126 and 127 (see Fig. 3) which are designed to be engaged by the calculating cam 128 (see Figs. 34 and 35), hereinafter referred to. As this cam is operated, the shaft 119 is rocked to bring about the result of shifting the calculating rack 117 into and out of mesh with the calculating wheel 118.

Rotatably mounted in a bearing in the side 13 (that is the right side of the frame) is the short adding shaft 129 having rigidly secured to its outer end and outside of the frame, the adding lever 130 (see Figs. 3 and 5.)

Rotatably mounted in the frame 13 a short distance beneath the shaft 129 is the short subtracting shaft 131 having rigidly secured to its outer end, outside of the frame the subtracting lever 132 which is outside of the adding lever a slight distance, so that they will not conflict in operation.

Secured to the inner end of the adding shaft 129 is a lever 133 (see Fig. 4) which is operatively connected at its upper end with the master-plate, to be hereinafter described. Secured to the inner end of the subtracting shaft 131 is a lever 134 (see Fig. 4) which is operatively connected at its upper end to the master-plate just referred to.

Secured to the adding shaft 129 immediately outside of the lever 133, is a cam 135 having a projection 136 at its lower rear extremity, as shown in Fig. 4. Secured to the shaft 131 and immediately outside of the lever 134 is a cam 137 having a projection 138 on its upper forward extremity. Connecting an eye 139 on the cam 135 with an eye 140 on the cam 137 (see Fig. 4) is a contractile coil spring 141 which serves the purpose of returning either the adding or subtracting shafts 129 and 131, together with the parts connected with them, back to a normal position after they have performed their functions.

As shown in Figs. 3 and 5, there is a pin 142 extending outwardly from the side 13 for limiting the rearward movement of the adding lever 130 and a pin 143 extending outwardly from the side 13 for limiting the rearward movement of the subtracting lever 132.

The parts just mentioned, in connection with the adding and subtracting lever, are

not duplicated throughout the machine, as one of each of these parts is all that is necessary for performing their respective functions.

Extending inwardly from the side 13 and in front and slightly above the subtracting shaft is a shaft 144 (see Fig. 4) having a bell crank lever 145 thereon, on the rear end of one arm of which I have provided a roller 146, and on the lower end of the other arm of which I have provided a roller 147. Pivotally attached to the upper forward arm of the bell crank lever 145 is a slidingly mounted link 148 having a roller 149 at its upper end, so arranged as to pass either above or below a plate 150 on the master-plate, hereinafter referred to.

Mounted on the fixed shaft 151, which is secured to the side 13 of the frame is a bell crank lever having the two arms 152 and 153 thereon, as shown in Fig. 4. There is an angular depression 154 in the rear upper portion of the arm 152 designed to receive the roller 147 on the lower arm of the bell crank lever 145.

Pivotally attached to the lower end of the arm 153 of the bell crank lever mounted on the shaft 151 is a rod 155 which has a hook 156 at its forward end. This rod passes through a lug 157 which is secured to the arm 75, which operates the safety lock bar 80 and is mounted on the shaft 74.

There is a spring 158 on the rod 155 designed to engage the lug 157, so that when the rear end of the arm 152 of the bell crank lever is moved downwardly, and the lower end of the arm 153 is moved forwardly, this spring will rock the upper end of the arm 75 and draw the safety lock bar 80 forwardly, provided it is free to operate. If, however, it is not free to operate on account of one of the keys being partially depressed, the spring will not prevent the slight operation of the adding or subtracting lever, and thus there will be no breaking of the parts due to this operation.

I have provided a spring 159 which is connected at its upper end to the brace 160 secured to the side 13, and at its lower end to the arm 152 for normally maintaining this arm in contact with the roller 147, as shown clearly in Fig. 4.

By the arrangement of the parts thus described, the bell crank lever 145 is normally maintained in the position shown in Fig. 4. When the adding lever is operated by drawing it forwardly, the projection 136 on the cam 135 engages the roller 146 and forces this roller into the cam 137, locking the subtracting lever out of operation. This simultaneously forces the arm 152 downwardly for accomplishing the results above stated. When, however, the adding lever is released, it will be forced to its normal position, as shown in Fig. 5, and these parts just referred to will assume their normal position.

When the subtracting lever is operated, the projection 138 on the cam 137 will engage the roller 146 and force the roller upwardly, and rock the bell crank lever 145, throwing the roller into engagement with the cam 135, and locking it and the adding lever out of operation. The other parts are operated in the same manner as above indicated.

When the adding lever is operated, the link 148 is moved downwardly so that the roller 149 engages the under surface of the bar 150 to lock the bell crank lever 145 at its lower limit of movement during the operation of the master-plate, at the completion of which operation it automatically releases itself.

When the subtracting lever is operated, the link 148 is moved upwardly so that the roller 149 engages the upper surface of the plate 150 and normally locks the bell crank lever 145 in the proper position throughout the entire operation of the master-plate, at the completion of which operation, these parts are automatically released, and are forced back to their normal position on account of the inclined edge of the angular notch 154, and the action of the spring 159.

To the lower end of the lever 134 I have pivoted an operating slide bar 161 (see Figs. 1 and 4) which extends rearwardly to a guide block 162, having a slotted opening 163 extending longitudinally of it, as shown in Fig. 36. The rear end of the operating slide bar is inclined at 164 to engage a roller 165 at the left end of the slide bar 166 which extends transversely of the bottom of the machine toward the left side.

Pivotally connected to the left end of the slide bar 166 is a rock arm 167 (see Fig. 36), which rock arm is secured at its other end to the cam controlling rock shaft 168. This rock shaft has its bearings 169 and 170 in the bottom 10, and on the side 12 of the frame, as shown in Fig. 2. There is a spring 171 for normally holding the slide bar 166 in engagement with the slide bar 161 at all times, and also holding the shaft 168 and the parts connected with it in a normal position.

Rigidly secured to the shaft 168 is a shifting lever 172 (see Figs. 2 and 34), having the forked rear end 173 thereon, in each prong of which there is a slot 174 as best shown in Fig. 34.

Extending transversely of the central portion of the machine, and mounted in the sides 12 and 13 is a main driving shaft 175, near the left end of which the cam 128 is mounted, as shown in Figs. 2 and 34. This cam is capable of a slight longitudinal adjustment owing to the fact that it is feathered to the shaft 175, as shown clearly in Fig. 34. On the inner end of the cam

bearing 176 I have rotatably mounted a collar 177, to which the prongs 173 of the cam shifting lever are connected by means of pins 178 entering the slots 174, thus allowing for the cam 128 to be rotated with the main driving shaft 175, and at the same time shifted longitudinally of this shaft in certain of the operations.

On the bearing of the cam 128 I have provided an adding flange 179 and a subtracting flange 180, which are spaced apart a slight distance. In the inner face of the adding flange there is a cam groove 181. In the face of the flange 180 adjacent to the flange 179 there is a cam groove 182.

The operating arm 125, which throws the calculating rack bar 117 into or out of mesh with the calculating wheel 118 (as previously explained) has its free end between the flanges 179 and 180 of the cam 128, and it is held in such position that the rollers 126 and 127 will enter the cam grooves 182 and 181 respectively, as the cam 128 is shifted. The roller 127, however, is normally in the cam groove 181, as this is the adding flange and it is the one that is normally used the greater part of the time. When, however, the subtracting lever is manipulated, the lower end of the lever 134 moves the slide bar 161 rearwardly, and this causes the slide bar 166 to move transversely of the machine for moving the cam shifting lever in such a way that the cam 128 will be shifted toward the left side of the machine, and the roller 126 will enter the cam groove 182, and out of the adding flange 179 for performing the subtracting function. The cam 181 is so arranged that as the main driving shaft is operated, the calculating rack bar 117 will be thrown into engagement with the calculating wheel 118 when this rack is at its lower limit of movement, so that the calculating wheel will be rotated for adding on the up stroke of the calculating rack bar 117, and this rack bar will be thrown out of engagement with the calculating wheel 118 on the down stroke of said calculating rack bar.

When the cam 128 has been shifted from the subtracting lever, so that the roller 126 enters the subtracting cam groove 182, the calculating rack bar 117 will be thrown into mesh with the calculating wheel 118 when this rack bar is at its upper limit of movement, and the calculating wheel will be rotated on the down stroke of the rack bar, and the rack bar will be thrown out of engagement with this calculating wheel on the up stroke of said rack. Thus the rotation of the calculating wheel is reversed by the adding and subtracting flanges 179 and 180 through the operation of the adding and subtracting levers.

Substantially parallel with the sliding bar 161 is a similar sliding bar 183, the rear end of which extends through the slot 163, and the guide 162, and has an inclined forward end 184 of substantially one-half the height of the inclined portion 164 of the bar 161. This inclined end engages the roller 165 as it is forced forwardly and moves the bar 166, and with it the shaft 168, and the cam shifting lever 172, and the cam 128 to position where the rollers 126 and 127 will be at a neutral position between the adding and subtracting flanges, and out of the cam groove 181 and 182; that is, in the position shown in Fig. 34, thus holding the rack 117 out of mesh with the calculating wheel 118 throughout the entire operation of the machine when the operating bar 125 is in this position. The roller 165 in this latter instance rests upon the top of the bar 183.

Pivotally connected with the forward end of the bar 183 is a bell crank 185, which is mounted on the stub shaft 186, attached to the right side of the machine, and in front of the shaft 131, as shown in Figs. 1, 4 and 42. The forward end of this lever is pivoted to a key stem 187, to the upper end of which is attached the printing key 188. There is a notch 189 in this printing key designed to lock the key down in position for printing when the metal forming the lower portion of this notch engages the keyboard.

It will be thus seen that when this key is locked down, the operative parts of the device are allowed to be manipulated without affecting in any way the action of any of the calculating wheels 118. There is but one of these printing keys, and the parts connected with it are not duplicated.

There is a spring 190 connected with the key stem 187 and the side 13 of the frame for returning the key to its normal or upper limit of movement.

On the key stem 187 there is a lug 191 which is engaged by the totaling lever, hereinafter described, for depressing the printing key and throwing it into printing position at the time the total is taken. There is also a lug 192 extending laterally from the key stem 187, and below the point of attachment of the spring 190 to this key stem, designed to be engaged by the pin on the master-plate for automatically releasing this key and allowing it to be returned by the spring 190 to its normal position. A detail view of the printing key is shown in Fig. 40.

"The master-plate."

Extending transversely of the machine and adjacent to the printing lever is a grooved roller bearing shaft 193 having a grooved roller 194 thereon. Extending transversely of the machine and above, and at the rear of the shaft 193 is a grooved roller bearing shaft 195, having the grooved roller 196 thereon. Mounted on the main

driving shaft 175 is a grooved roller 197. The grooved rollers 194 and 197 are substantially in line with each other, as shown in Fig. 4.

5 Mounted on the rollers 194 and 197, and in engagement with the grooved roller 196, is the master-plate 198 having at its forward end an arm 199 which moves longitudinally on the grooved roller 194, and at its rear end 10 a two part guide 200 engaging the upper and lower portions of the grooved roller 197, so that the master-plate will be kept from vertical movement in its horizontal action at the rear end. The upper portion of the 15 master-plate engages the lower portion of the grooved roller 196, so that the forward end is held against upward movement as it is moved horizontally. This master-plate, of which there is but one used in the machine, 20 is adjacent to the right side of the machine, and a large part of all of the operations of the machine are performed through this plate. Figs. 33, 38 and 39 show detailed views of the master-plate. There is a toothed surface 201 25 in the upper rear edge of the master-plate designed to be engaged by a locking dog 202 which permits the master-plate to move forwardly, but prevents its rearward movement until a complete stroke of said master-plate 30 has been taken. At the outer end of the arm 199 is a pin 203 which is designed to be engaged by the extreme rear end of the safety lock 79, after the master-plate has been moved a slight distance, which pin and 35 lock together prevent the operation of the master-plate 198, and of the adding and subtracting levers, until these levers are allowed to be thrown over by the release of this safety latch through the cams 135 or 137. 40 The purpose of this latch and pin is to prevent the operation of the master-plate, and of the subtracting and adding levers, provided anyone of the keys in the key-board is partially depressed, and it enables the op- 45 erator to ascertain that there are incomplete operations in the machine, and allows him to remedy these prior to his putting the operative parts of the device into operation. As soon as the partially depressed key has 50 been righted, either the cam 135 or 137, depending upon whether the adding or subtracting lever is operated, operates to raise the free end of the safety lock 79 out of contact with the pin 203, and allows the master- 55 plate to continue its forward movement. This pin 203, and the safety lock 79, with its operative parts, are best shown in Fig. 4.

Mounted on the right side of the master-plate 198 and near the top portion thereof, is 60 a channeled two-faced track 204, the faces of which are on the upper and lower portion thereof. Secured to the stub shaft 205, which extends through the master-plate 198 in front of the track 204, is a substantially 65 V-shaped switch 206, designed to be normally held with its pointed end at its lower limit of movement, as shown in Figs. 38 and 39, which is its position in the adding operation to receive a roller 207 on the rear end of the bell crank lever 208, which is mounted 70 on the shaft 209. The upper forward end of the bell crank lever is pivoted at 210 to a connecting rod 211, which is connected with an arm 212 secured to a crank shaft 213 (see Fig. 1), adjacent to the calculating 75 mechanism and mounted in the sides of the machine. As the roller 207 moves upwardly over the switch 206 and the track 204, while the master-plate is moved forwardly, the rod 211 is drawn forwardly, and places the add- 80 ing spring in the calculating mechanism, hereinafter referred to, under tension. When the switch 206 is turned to its upper limit of movement automatically by the subtracting lever, through a mechanism here- 85 inafter referred to, and the master-plate is moved forwardly, the roller 207 passes beneath the switch 206 and engages the lower face of the track 204, causing the rod 211 to be moved rearwardly for rocking the 90 crank shaft in that direction, and placing the subtracting spring in the calculating mechanism, hereinafter referred to, under tension.

Referring to Figs. 38 and 39, there are 95 two blocks 214 and 215, having inclined rear ends 216 and 217 mounted on the forward end of the right side of the master-plate 198, between which the roller 207 on the bell crank lever 208 stands when the master- 100 plate is in a normal position. When the master-plate is being returned from its extreme limit of movement, and the roller 207 engages either the upper or lower surface of the track 204, either the inclined end 216 105 or 217 engages said roller, and draws the bell crank lever 208, and the parts connected with it, back to their normal position.

Mounted on the shaft 175 and adjacent to the right side of the master-plate 198 is a 110 gear 218 which is in mesh with a rack sector 219, mounted on the stub shaft 220, which is secured to the side 13 of the frame. Mounted on the side plate 13 and in front of the rack sector 219 is a pin 221, and mounted on 115 the rack sector 219 is a pin 222. Pivotally attached at its outer ends to the pins 221 and 222 is a toggle 223 whose central pivot 224 is substantially mid-way between its ends. Pivotally mounted in the pin 221 is a toggle 120 releasing lever 225, shown clearly in Figs. 38 and 41, which is designed to be engaged by a pin 226 on the right side of the master-plate 198 for swinging the upper end of the toggle forwardly when said pin engages it 125 and breaks the point of the toggle releasing it, and allows the rack sector to be operated at the proper time. There is a pin 227 in the side 13 of the frame, designed to be engaged by the toggle releasing lever 225 when 130

at its upper limit of movement, and thus maintain the toggles in their normal and properly locked position.

Pivotally attached at one end to the forward central portion of the right side of the master-plate and secured at its rear end to a rotatable shaft 228, is a two link toggle 229 pivoted at its central portion. Secured to the shaft 228, which is rotatably mounted in the side 13, is a releasing lever 230. This toggle is designed to have its parts most nearly together when the toggle 223 is extended; that is, when the master-plate is at its normal position.

As the master-plate approaches its forward limit of movement, this toggle 229 extends simultaneously with the falling of the toggle 223, and when the master-plate reaches its extreme forward position, the toggle 229 is fully extended, and engages the pin 231 on the master-plate 198 and locks the master-plate against rearward movement until the releasing lever 230 is engaged by a pin 232 on the rack sector 219. The purpose of this toggle locking device 229 is to retain the master-plate at its forward limit of movement until the action of the other parts of the device has been completed. When this toggle is released, the master-plate is allowed to be withdrawn to its point of starting by the mechanism hereinafter described.

"*Speed regulating mechanism.*"

Pivotally mounted in the extreme rear lower portion of the frame of the machine and adjacent to the side 13 thereof, is a dash-pot 233 (see Figs. 1 and 38) having a piston head 234 slidingly mounted therein, to which is secured a piston rod 235 for the bell crank lever 236, which bell crank lever is mounted on the stub shaft 237, which is secured to the side 13 of the frame. The lower end of the bell crank lever has pivotally attached to it a connecting rod 238. This connecting rod 238 is attached at its forward end to the pin 222 on the rack sector 219.

Connecting the lower portion of the bell crank lever 236 with the lower rear end of the master-plate 198 is a spring 239 designed to be placed under tension as the master-plate is moved to its forward limit of movement. As this master-plate is moved forwardly, the toggle 223 is released, and the spring 239 acting on the bell crank lever 236, will draw the piston in the dash-pot 233 to its upper limit of movement gradually; that is to say, the piston in the dash-pot will regulate the speed of the operative parts of the mechanism which are operated by the rack sector 219 after the spring 239 has been placed under tension, regardless of the speed at which the subtracting or adding lever is operated, thus providing a safety device for preventing the delicate parts of the device being operated at too rapid a rate of speed. Connected with the rear end of the master-plate and with the back portion 11 of the frame is a spring 240 for drawing the master-plate to its rearward limit of movement as soon as the point of the toggle 229 has been released from its locked position.

The speed of the rearward movement of the master-plate is regulated also by the dash-pot through the mechanism above described.

On the upper left side of the master-plate I have provided a pin 241; upon which is slidingly mounted the slotted link 242, as shown in Fig. 4. The forward end of the slotted link is pivotally connected with the lever 133 which is secured to the adding shaft 129. These parts are so arranged that as the adding lever 130 is swung forwardly, the link will draw the master-plate forwardly against the resistance of the springs 239 and 240. On the lower portion of the right side of the master-plate is a pin 243, upon which is slidingly mounted the slotted link 244, the forward end of which is connected with the lever 134, which is mounted on the subtracting shaft 131, and is so arranged that as the subtracting lever 132 is swung forwardly, the master-plate will be drawn forwardly by the link 244 against the resistance of the springs 239 and 240. Owing to the construction of these links 242 and 244, when the adding lever is moved forwardly, the subtracting lever and the slotted link 244 will remain stationary, and also when the subtracting lever is moved forwardly, the adding lever and the link 242 will remain stationary.

Pivotally connected with the upper rear end of the subtracting link 244 is a switch operating bar 245 having a pin receiving notch 246 in its forward end. This notch is designed to receive a pin on an arm 247 secured to the switch shaft 205.

Mounted on a stub shaft 248 (see Fig. 4) is a hanger 249, having a pin 250 at its lower end, designed to enter a notch 251 in the switch operating bar 245, a slight distance at the rear of the notch 246. This hanger 249 is designed to maintain the forward end of the switch operating bar 245 at its upper limit of movement when out of contact with the pin on the arm 247, as the master-plate moves forwardly from the operation of the adding lever. This causes the switch 206 to be retained at its normal position for adding, as shown in Fig. 38 when the master-plate is operated by the adding lever. When, however, the subtracting lever is used to operate the master-plate 198, the slotted link 244, operating on the switch operating bar 245, which engages the pin on the arm 247, rocks the shaft 205 and

causes the switch to be thrown to its upper position on account of the slight movement of the slotted link 244 before its rear end engages the pin 243; that is, the switch is first turned, and then is retained in a position by this switch operating bar during the subtracting operation as the master plate moves simultaneously with the link 244.

Extending downwardly from the forward end of the master-plate is a roller bearing member 252, having the roller 253 in its lower end, as best shown in Figs. 38 and 39. Pivotally attached to the right side of the machine and a slight distance from the forward portion thereof are two pivotally mounted bars 254 and 255, substantially parallel with each other, as shown in Figs. 1 and 4. To the rear ends of these bars I have pivotally attached the connecting bar 256 having an extension 257 on its forward side. Pivotally attached to the pivotal connection between the links 255 and 256 is a dog 258 (see Fig. 4) held in position by a spring 259 to engage the roller 253, in taking the total when the master-plate is moved forwardly, and after the totaling button has been depressed.

Pivotally attached to the forward end of the bar 255 is a bar 260, which is pivotally attached at its lower end to an arm 261 on the shaft 56. There is a dog 262 pivotally attached to the upper end of the bar 260, having a rounded outer end. There is a spring 263 connected with an extension of the bar 260 at one end, and at its other end to the rear of the dog 262, designed to hold the dog normally in position for receiving the roller 253 on the forward end of the master-plate as this master-plate is returned to its rearward limit of movement, the said roller having first passed over the end of the dog 262 by depressing said dog against the resistance of the spring 263.

As the master-plate is being returned and the dog 262 is engaged to force the bar 260 downwardly, the arm 261 causes the shaft 56 to be rotated, and the bars 58 to be moved upwardly to engage the bar 51 and release the key catches 39 to supplement the action of the springs 44 and return the keys to their extreme upper limits of movement.

There is a spring 264 connected with the bar 260, and the side 13 for automatically returning the bar 260 and the parts operatively connected with it, to a normal position after the roller 253 has left its engagement with either the dog 262 or 258.

Slidingly mounted in the forward right hand portion of the key-board is a key stem 265 having a repeating key 266 at its upper end. There is a lug 267 on the key stem 265 designed to engage a pin 267′ on the dog 262 when this key is depressed, so that the roller 253 will not act on the dog 262. This causes the keys which have been depressed to be retained in that position during repeated operations of the adding or subtracting levers, and hence add into the machine for any number of times desired, a given number which is repeated in the addition or subtraction.

The repeating button 266 is retained at its lower limit of movement by a catch 268 which engages the key-board. When this button has been once depressed, the machine will repeat indefinitely the numbers indicated by the keys which are depressed until this button is released and forced to its upper limit of movement by the spring 269, which is connected with the key stem, and with the side 13 of the frame.

Slidingly mounted in the key-board of the machine and immediately at the rear of the repeating button, is a key stem 270 having the error key 271 at its upper end. The lower end of this key is designed to engage a pin 272 on the right side of the bar 255, which is designed to be pushed downwardly by the operator for actuating the bar 260, and the parts operatively connected with it for throwing the keys which may have been depressed by mistake, together with the other operative parts, back to their normal position. There is a spring 273 connected with the projection on the key stem 270 and with the frame of the machine for returning this to its normal position when it has been used.

On the right side of the arm 199 is a track 274 (see Fig. 37) which operates a portion of the totaling mechanism, hereinafter described. Slidingly mounted on this track 274 is a block 275 having an inclined face 276 thereon. This block is maintained at its forward limit of movement by the spring 277, as shown clearly in Fig. 37 of the drawings. This block forms a portion of the totaling mechanism, referred to. The gear 218, above referred to, is rotatably mounted on the main driving shaft 175. Rigidly secured to this shaft 175 and on the left side of the gear 218 is an arm 278 (see Figs. 29 and 30), to the upper end of which is pivoted a dog 279, which is limited in its downward movement by a pin 280 engaging the metal forming the lower end of the slot 281, in the arm 278. There is a spring 282 for normally holding this dog 279 at its lower limit of movement, which spring is secured to the pin 280 and to the arm 278.

The free end of the dog 279 is curved to receive a pin 283 extending outwardly from the gear 218. This arm 278 and dog 279 are so arranged that as the rack sector 219 swings forwardly, the dog 279 will engage the pin 283 and rotate the main driving shaft 175 for carrying out the operation of the parts connected with this driving shaft. When the rack sector 219 is operated on in

its return stroke, the gear 218 rotates on the shaft 175 without operating it. At each operation of the rack sector, the gear 218 drives the main driving shaft 175 a complete revolution before the rack is allowed to return.

There is a crank 284 in the main driving shaft 175 which is operatively connected by a connecting rod 285 (see Fig. 28) with an arm 286 rigidly secured to the right end of the crank shaft 96, to which each of the pin bearing frames 97 are secured, so that as the main driving shaft is operated from either the adding or subtracting lever through the mechanism above described, the rock shaft bearing the pin frames, is operated to move the calculating rack 117 the number of points determined by the setting of the pins controlled by the keys in the key-board.

"The calculating or carry over mechanism."

Extending transversely of the frame and mounted in the sides 12 and 13 is a channel bar 287 having a series of eleven notches in its upper portion, each of which notches being designed to receive in it the rear lower corner of one of the eleven calculating or carry over sections which this channel bar 287 is designed to support. For the purposes of convenience I shall refer but to one section, and show its relation to the next one, as these calculating sections correspond throughout in their construction and operation. Extending longitudinally of the channel bar 287 and mounted in the channel thereof is a removable rod 288 (see Fig. 2), designed to enter a notch 289 in the lower rear corner of the sides 290 and 291 of each of the calculating sections, as shown in Fig. 24. The upper rear portion of the side plates of the calculating section has an opening 292 extending through each of them, through which a removable rod 293 is passed, supported at its end portions by a frame 294 that is secured to the sides 12 and 13 of the frame of the machine, as shown in Figs. 1 and 2. The rods 293 and 288 may be readily removed from the exterior of the machine so that each of the calculating sections may be removed from the machine independently of the rest, the remaining calculating sections being temporarily held in position by the engagement of one of its parts with the crank shaft 213. The calculating sections comprise the two side plates 290 and 291 which are connected to each other by means of the pins 295, 296 and 297, as shown in Fig. 24. Each of these pins has a semi-annular groove 298, which is outside of the side 291 when the sections are assembled. There is a locking lever 299 (see Figs. 1 and 2) pivoted at its central portion to the outside of the plate 291, and is so constructed at its end portions as to enter the semi-circular grooves 298 in the pins 295 and 296, and lock the side 291 by means of these pins to the side 290. There is a locking catch 300 pivoted to the upper rear corner of the side 291, so constructed that its lower portion will enter the semi-circular groove 298 of the pin 297 for maintaining this portion of the side 291 through the pin 297 to the side 290. By simply moving the locking lever 299 and the locking device 300 on their pivots, and out of the slots 298, the side 291 may be readily removed from the calculating section after this has been removed from the machine so that ready access may be had to the interior and operative parts of this mechanism without the use of tools, and hence the calculating section may be both removed from the machine, and disassembled without the use of tools, and very readily.

Extending transversely of the lower forward portion of each of the calculating sections is a bearing 301 having mounted on it near the plate 290 a swinging operating plate 302 (see Figs. 20, 21 and 25), having a slot 303 at its lower end designed to fit over the crank shaft 213 which is operated from the bell crank 208 by the switch 206 on the master-plate as the master-plate is moved forwardly.

Mounted on the pin 301 and adjacent to the side 291 of each of the calculating sections, are two arms 304 and 305 (see Fig. 21) which are held in their proper position relative to the operating plate 302 by means of the lugs 306 and 307 on these arms, which engage a projection 308 on said operating plate, as shown clearly in Fig. 21. The rear end of the operating plate 302 has two engaging surfaces 309 and 310 for holding a swinging plate in the calculating mechanism in the proper position.

There is a locking arm 311 on the operating plate 302 for forcing the catch 312 into a locked position relative to the swinging plate above referred to, by having its rear end enter the notch 313 in said substantially semi-circular plate, which I have numbered 314. This swinging plate is mounted on a bearing 315 at the central portion of each calculating section.

As best shown in Fig. 26, there is a channel 316 in the outer rear portion of the plate 314 in which is slidingly mounted a block 317 secured to a carrying and retaining gear segment 318, the lower end of which has a channel 319 for receiving a roller 320 mounted on the bearing 315, and which, together with the block 317, hold the carrying and retaining gear segment in sliding relation to the swinging plate 314, and enable it to be moved forwardly and rearwardly relative to said swinging plate 314. The teeth of the gear segment 318 are designed to mesh with the teeth of the calculating wheel 118. When thus in mesh, the gear segment is designed to rotate said wheel one-

tenth of its complete revolution at the proper time for carrying numbers added or subtracted from one column to the next, and also for retaining the calculating wheel 118 against rotation during certain of the operations, and while the machine is not being operated.

In the outer lower periphery of the swinging plate 314 is a notch 321 designed to be engaged by a catch 322 which is pivotally secured to the rear end of each calculating section. There is a spring 323 connected with this locking catch at one end, and connected with an operating lever 324 pivotally and slidingly connected with the side plate 291 as best shown in Fig. 23. The lever 324 is also pivotally and slidingly connected with the carrying and retaining gear segment by the stud 324′ thereon passing through the slot 325 in the segment, as shown in Fig. 25.

The rear end of the operating lever 324 has a hook 326, which is designed to hook over the shaft 122, connected with the arms 120, and the blocks 123 (see Fig. 2) in such a way that as the carrying rack bar 117 is swung into and out of engagement with the calculating wheel 118, the operating lever 324, and with it the gear segment 318, will be moved forwardly and rearwardly respectively, and hence the said gear segment will be thrown out of and into mesh with the calculating wheel 118.

There is a lug 327 on the operating lever 324, (shown in Fig. 2) designed to engage the upper portion of the catch 322 for holding this catch out of the notch 321 when the rack bar 117 is out of mesh with the calculating wheel 118, and when the gear segment 318 is in mesh with said calculating wheel 118. When the rack bar 117 is thrown into mesh with the calculating wheel 118, and the gear segment 318 is out of mesh with said calculating wheel, the spring 323 will cause the catch 322 to enter the notch 321 and retain the plate 314 in a fixed position.

The forward ends 328 and 329 of the plate 314 are so shaped as to be engaged by the engaging surfaces 309 and 310 of the operating plate 302 (see Fig. 20) when this operating plate is drawn back to its normal position by the return of the master-plate through the blocks 214 or 215 acting on the bell crank 208, and also to retain this swinging plate 314 against rotation until the engaging surfaces 309 and 310 are out of engagement with the forward ends 328 and 329 of the swinging plate.

Pivotally mounted on the bearing 315, and in contact with the swinging plate 314 is an auxiliary swinging plate 330 having two lugs 331 and 332 extending outwardly from it. Connecting the lug 332 with the arm 305, which is operated by the operating plate 302, is the adding spring 333. Connecting the lug 331 with the arm 304, which is operated by the operating plate 302 is the subtracting spring 334. In the outer portion of the auxiliary swinging plate 330 is a notch 335 in which operates a pin 336, secured to the swinging plate 314. This pin is of less width than the notch 335, so as to allow a certain movement of the auxiliary plate 330 when the adding or subtracting spring is under tension relative to the plate 314, before these plates act together. The auxiliary plate 330 is provided with a notch 337 which is in line with the notch 313 on the swinging plate 314 when these plates are in their normal lock position, as shown in Fig. 26. These two notches are designed to receive the end of the catch 312 simultaneously when the plate 314 and the auxiliary plate 330 are in their normal position. When the adding or subtracting spring is placed in tension, the auxiliary plate 330 is advanced the slight distance allowed by the difference in dimensions of the notch 335 and the pin 336. If the adding spring is operated, the catch 312 will be engaged by the metal forming the forward corner 341 of the notch 337, as shown in Fig. 24; if the auxiliary plate 330 is operated by the subtracting spring in the opposite direction, the catch 312 is engaged by the metal forming the rear of the notch 337. The catch 312 is raised out of the notches 313 and 337 by the action of the lever 338 in the adjacent section at the right (see Fig. 24), the roller 339 of said lever engaging the lateral projection 340 on the catch 312. This prevents the catch 312 from dropping back into the notches 313 and 337, while the catch 322 is within the catch 321. The plate 314 is thus held against rotation until it is released by the lug 327 on the operating lever 324 acting against the catch 322, at the time when the calculating rack 117 is thrown out of engagement with the calculating wheel 118.

As shown in Fig. 27, the calculating wheel, to which I have frequently referred heretofore, comprises the gear 118ᵃ, and a numeral indicating wheel 118ᵇ secured to said gear, having on its periphery numbers running consecutively in order from 0 to 9 around said wheel and spaced equi-distant apart in such a way that these numbers are readily observable through the glass 18 in the front of the machine.

There is a shaft 341 in each calculating section, to which the parts 118ᵃ and 118ᵇ of the calculating wheel 118 are secured. Rigidly mounted upon the left end of this shaft is a total taking calendar 342, shown clearly in Fig. 24, comprising a segmental plate having a series of nine notches 343 in its outer edge, which for the sake of con-

venience, I have additionally numbered, beginning with the one farthest from the center, 1[c], 2[c], 3[c], 4[c], 5[c], 6[c], 7[c], 8[c], 9[c].

Mounted on a pin on the indicating wheel 118[b], and extending toward the calendar 342, is a roller 344 (see Fig. 24) designed to engage the operating lever 338 in one section, and force its rear end downwardly upon each revolution of the shaft 341 to thereby raise the catch 312 out of the notches 313 and 337 in the plates 314 and 330, respectively, of the adjacent section.

"*Operation of the calculating mechanism.*"

The purpose of the calculating mechanism is primarily to retain the wheel in position while the calculating rack bar 117 is out of mesh with said wheel, and to transfer by said calculating mechanism a number into the column at the left after the calculating wheel of a given section has been rotated a complete rotation or more when the machine is adding, and if the machine is subtracting and the particular calculating wheel 118 is rotated, a complete revolution or more, the calculating wheel in the section at the left is rotated in the subtracting direction to reduce the number in that section one point through the mechanism of these sections.

Assuming that the adding operation is to take place, the calculating mechanism is in the normal position shown in Fig. 20; that is, the operating plate 302 is in engagement with the swinging plate 314, the gear segment 318 is in mesh with the calculating gear 118[b], and is locked in that position by said gear segment, and other parts in operative relation to it, the rack 117 is out of mesh with the calculating wheel, and the master-plate is at its rearward limit of movement.

As the master-plate moves forwardly, the switch 206 first causes all of the operating plates 302 to be drawn forwardly at their lower ends by the shaft 213 and its connections, and the adding spring 233 in each of the calculating sections placed under tension, as shown in Fig. 25.

As soon as this operation has taken place and the master-plate continues its movement forwardly, the toggle 223 is released, and the main driving shaft allowed to operate for drawing the rack 117 into mesh with the calculating wheel 118 through the cam 128. Simultaneously with this action the gear segment 318 is forced out of mesh with the calculating gear 118 in each calculating section, and the catches 322 are allowed to enter the notches 321 in each of the swinging plates 314. The rack then continues its upward movement the number of points indicated by the key which controls its operation.

When the calculating wheel has been rotated a single revolution, the roller 344 engages the operating lever 338 and raises the catch 312 in the adjacent section to the left, and causes said catch to engage the periphery of the swinging plate 330, owing to the differences in dimensions between the slot 335 and the pin 336, as hereinbefore described. This catch is held against the outer periphery of the swinging plate 330 and the operating arm 338 is held at its upper limit of movement by a spring 345 connecting this catch 312 with the operating lever 338. This spring also serves to return this catch and lever to their normal positions.

The racks 117 then continue their upward movement until this has been completed, at which time they are forced out of engagement with the calculating wheel 118, and the gear segment 318 drawn into mesh with the gear 118[a] of the calculating wheel, as shown in Fig. 20, and the catch 322 drawn out of the notch 321 in the swinging plate 314 which allows the adding spring 333 to exert a pulling force on the swinging plates 330 and 314, and causes the gear segment 318 to be drawn downwardly at its rear end for advancing the calculating wheel one point in this calculating section to the left of the one first described, thus causing one additional number to be added into the section to the left of the one in which the numbers were originally added, thus carrying the numbers from one section to another upon each complete revolution of the calculating wheel.

The operation is just reversed in the subtracting operation; that is, as the parts are operated for subtracting, one number is subtracted out of the calculating mechanism at the left on each complete revolution in a subtracting direction of the calculating wheel by the action of the subtracting spring 344.

"*Gear segment returning device.*"

Rigidly secured to the shaft 119 upon which is mounted the arm 120 for throwing the rack into and out of gear, is an operating lever 346, as shown in Fig. 1. Pivotally connected with the forward end of this operating lever 346 is a spring maintained dog 347 which is pressed downwardly by a pin 348 at the rear end of the master-plate, as the master-plate moves forwardly. As the master-plate is returned, the pin 348 engages the dog during a certain portion of the stroke of the master-plate, and forces the operating lever 346 downwardly to rock the shaft 119 in such a way as to move the upper end of the lever 120 forwardly and force the calculating racks 117 into mesh with the calculating wheels 118. This causes the lever 326 to force the gear segment 118 out of mesh with the calculating wheel 118 at the time the rack 117 is forced into mesh

with the calculating wheel 118. While the rack 117 holds the calculating wheel 118 in position, the adding or subtracting spring 333 or 334, depending upon which action is being performed, is by the operation of the operating plate 302 caused to force the swinging plates 314 and 330, and with them the gear segment 318 and catch 312 back to normal position. The spring 349 (see Fig. 1) then returns the calculating rack 117 back to its position, out of engagement with the calculating wheel 118, and the parts are in the position shown in Fig. 20, and ready for further operation.

"The printing mechanism."

There is an arm 350 integral with each of the eleven bell crank levers 115, hereinbefore referred to, as shown in Fig. 2. Pivotally connected with the lower end of each of these arms is an operating bar 351, each of which operating bars is pivotally connected with an arm 352 as shown in Fig. 3. Each of these arms is secured to a shaft 353 extending transversely of the machine which are arranged one above the other and slightly out of vertical line, as shown in Figs. 2 and 3.

Secured to each of the shafts 353 is an operating arm 354, which operating arms are so arranged that they will be slightly out of line with each other; that is, the lowermost arm is adjacent to the right end of the shaft, and the others in consecutive order are set a little to the left of the shafts above, so that they will be free to operate.

Pivotally attached to the rear end of each of the arms 354 is a link 355 which is pivoted at its rear lower end to a bar 356. Each of these bars 356 is mounted on a shaft 357 extending transversely of the machine and near the rear upper portion thereof.

Pivotally connected to each of the links 355 is a type bar 358 having a row of type 359 on its upper end, the type of which represent the numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, running in consecutive order from the top to the bottom, as shown in Fig. 46.

Owing to the construction thus described, as the bell crank 115 is swung a certain distance to elevate the calculating rack bar 117, the operating bar 351 is raised a corresponding distance to raise the type bars 358 which have been set by the keys to a proper position for printing the number on said type bar corresponding to the number on the key which controls this operation.

Mounted on the upper portion of the back 11 of the frame is a support 359ª (see Fig. 46), to the outer end of which is pivotally mounted a swinging member 360 which has two bar supporting plates 361 at each end of it which extend rearwardly and between which the bars 358 are mounted.

Extending rearwardly from the bar 362 is a series of plates 363 (see Figs. 43 and 53), between which plates and through an opening in the support 359ª, the type bars 358 extend, and by which the upper ends of these type bars are supported. Each of the type bars 358 has a lateral projection 364 at its forward left side, each of which is designed to be engaged by a spring 365 secured to each of the plates 363, shown in Fig. 53. These springs are designed to normally hold the type bars 358 at their forward limit of movement out of engagement with the platen of the printing mechanism, hereinafter described, as this bar is raised and lowered.

Pivotally attached to the swinging member 360 is a series of levers 366, each having an operating block 367 at its upper end, as shown in Fig. 48. At the lower end of these levers 366 is an inclined projection 368, designed to be engaged by an inclined projection 369 on the extension 364 of the type bar 358 as this type bar is moved upwardly. This incline portion 369 is formed by cutting away a portion of the extension 364, as shown in Fig. 48.

The upper portions of these operating levers 366 are so arranged that as the upper portion of one lever 366 is swung to the right it will draw the blocks 367 of the levers at the right into line with the forward portions of all the type bars to the right. Therefore, when the swinging member 360 is swung to force the set type bar rearwardly, it will also force all the type bars to the right of the set type bar into engagement with the platen of the printing mechanism hereinafter described. The purpose of this construction is to print the "zeros" at the right of the set-up numbers without printing the "zeros" to the left. That is to say, if 100 were being added in, it would be necessary to print the two "zeros" at the right of the numeral 1, while it would be undesirable to print any zeros to the left of that number.

There is a series of springs 370 (see Figs. 43 and 46) for drawing the operating levers 366 to their normal position, so that the blocks will stand between the type bars 358, and unless the type bars have been operated upon, the numbers will not be printed, except the zeros to the right of the one in question, owing to the fact that the blocks pass between the type bars as stated.

The swinging member 360 is mounted on a shaft 371 to which there is rigidly secured an arm 372 which extends rearwardly from said shaft, as shown in Fig. 44. Pivotally attached to the rear end of this arm 372 is a

link 373, to the lower end of which is pivotally attached an operating lever 374, mounted at its central portion on a stub shaft 375 secured to the side 12 of the machine, as shown in Fig. 2. The extreme forward end of this operating lever 374 has a roller 376 on it which is designed to be engaged by a projection 377 on the cam 378, which is mounted on the extreme left end of the main driving shaft 175 of the machine, so that as this cam is rotated, the forward end of the operating lever 374 is raised to draw the link 373 downwardly and swing the upper end of the swinging member 360 rearwardly for forcing the proper type bars against the printing platen, hereinafter described.

Connected to the side 12 and to the rear portion of the operating lever 374 is a spring 379 for normally returning the operating lever 374, and the parts connected with it, together with the type bar 358 to their normal position. Mounted between the sides of the frame and its rear upper portion is a curved supporting frame 380 (see Figs. 5 and 46), having a roller bearing slot 381 running longitudinally of the forward edge, and transversely of the machine with rollers 382 mounted therein. At the opposite side of the curved supporting frame 380 is a roller bearing 383 having rollers 384 mounted therein. Slidingly mounted on the rollers 382 and 384 is a curved carrier frame 385 which extends transversely of the machine. There is a slot 386 in the curved supporting frame 380 and a slot 387 in the carrier frame 385, through which slots an operating lever 388 extends which is mounted on the shaft 389 extending transversely of the machine beneath the curved supporting frame 380.

Slidingly mounted relative to the carrier frame 385 is a platen frame comprising two end portions 390 and 391 (see Fig. 43) connected together by a bottom portion 404, between which is rotatably mounted the platen 392. At the right end of the platen is a gear 393 in mesh with the gear 394 mounted on a roller shaft 395, which roller shaft is adjustably mounted in the upper portions of the ends 390 and 391 of the platen frame. Upon this shaft is mounted the roller 396 which is held in constant engagement with the platen 392 by means of the springs 397 and 398 which are secured respectively to the ends of the shaft 395 and the plates 390 and 391. It is between this roller 396 and the platen 392 that the paper is designed to pass, upon which the numbers are printed by the type bars.

The roller 396 has four annular grooves 399, 400, 401 and 402, in each of which there is a spring 403 (see Fig. 51) which is secured at one end to the shaft 395, and at its other end to the bottom 404 of the platen frame, and is designed to guide the paper beneath the platen 392 and around its forward side and between said platen and the roller 396 to a point of delivery.

Extending downwardly and rearwardly from the ends of the shaft 405 which supports the platen 392 are the arms 406, and 407, between the lower ends of which there is mounted a shaft 408, as shown in Fig. 43. There is a notch 409 in the upper forward end of the operating lever 388 designed to receive the shaft 408 for operating it, as shown in Fig. 43. Extending rearwardly from the arm 406 is a pawl supporting member 410 (see Fig. 47) having a pawl 411 pivotally attached to and depending therefrom, the lower end of which engages the gear 393 and is held in such engagement by the spring 412. This pawl is so arranged that as the arm 406 is rocked forwardly at its lower end, the platen is rotated to advance the paper.

For operating the platen I have secured to the shaft 389 an arm 412[a] (see Figs. 5 and 58) having a series of openings 413 in it to which is adjustably secured, by means of a catch 414, a connecting rod 415 which is pivotally attached at its lower end to a lever 416 (see Fig. 2) pivotally attached at its rear end to the side 12 of the frame. The forward end of this lever is held against the periphery of the cam 378 by the spring 417, and as the cam 378 rotates the projection 377, forces the forward end of this bar 416 downwardly, and causes the connecting rod 415 to be drawn downwardly and hence operate the shaft 386 and the parts above described, which advance the platen. The adjustable features provided by the openings 413 and the catch 414 are to regulate the length of the stroke of the parts which drive the platen.

There is a hand piece 418 on the end of the shaft 405 by which the platen may be rotated manually, and there is a releasing catch 419 for throwing the pawl 411 out of contact with the gear 393, so that the platen may be rotated in either direction by the hand piece 418. The details of this catch are shown in Fig. 45.

Secured to the upper portion of the carrier frame 385, and extending transversely of the machine is a retaining plate 420 having a number of notches 421 in its forward edge, as shown in Fig. 43. Extending transversely of the printing mechanism and between extensions of the ends 390 and 391 of the platen frame are two shafts 422 and 423. Secured to the central portion of the shaft 423 is a catch 424 designed to enter any one of the notches 421 and lock the platen frame against longitudinal movement relative to

the carrier frame 385. There is a thumb lever 425 on the outer end of the shaft 423 for throwing the catch 424 out of any one of the notches 421 and allow the platen frame to be shifted in either direction. There is a spring 426 on the shaft 423 connected to the end portion 390 of the platen frame for holding the catch in the particular notch in which it is placed.

Pivotally mounted on the shaft 422 are two bell crank levers 427 and 428, between the rear arms of which is mounted a paper bearing roller 429, upon which the roll of paper 430 is designed to be mounted. Between the other arms of the bell crank lever 427 I have provided a paper guide 431, shown in Fig. 45, and between the extreme outer ends of said arms there is a serrated knife 432, so arranged that as the paper passes between the guide 431 and the knife 432, the paper may be easily thrown against the serrated edge of the knife 342, and be severed from the roll. This paper roll is capable also of longitudinal movement on the shaft 422, and there is a set screw 433 for locking it in any desired position on said shaft.

On the interior of the platen 392 there is a mechanism for allowing the platen to be straightened for placing the paper in alinement. A detail description of this, however, is deemed unnecessary.

It will be seen by the use of the mechanism thus described, that when the paper is inserted between the platen 392 and the roller 396, it will be advanced to printing position so that the type bars may be forced against it, and the numbers printed on this paper by the mechanism heretofore described.

Mounted near the forward end of the under side of the carrier frame 385 is a roller 434 (as shown in Fig. 55). Connecting the carrier frame 385 with the curved supporting frame 380 is a spring 435 (see Fig. 55) for normally maintaining the said carrier frame in its normal position so that its right end is substantially in line with the right end of the supporting frame 380. Slidingly mounted between the right end of the carrier frame 385 and the supporting frame 380 is a lever 436 (see Figs. 5 and 55) having an inclined upper edge designed to engage the roller 434 as the lever 436 is moved upwardly, and force the carrier frame toward the left of the machine, so that the numbers on the type bar 358 will be printed in a different column when the carrier frame 385 and the platen frame mounted in it are thus shifted. The lower portion of the lever 436 is slidingly mounted in a support 437 (best shown in Figs. 56 and 57) on the inside of the side 13 of the frame, which support is slotted to permit the lever 436 to have a slight lateral play. There is a roller 438 on the extreme lower end of the lever 436, designed to engage a cam 439 secured to the subtracting shaft 131, so that as the subtracting lever is operated, the lever 436 will be moved upwardly and will shift the carrier frame 385 and the platen frame to a position for receiving the impressions of the type in a different column from that normally used. There is a spring 438[a] for normally holding the lever 436 at its lower limit of movement.

Slidingly mounted in the support 437, and having in its lower end a cam groove 440 (see Fig. 56), through which the lever 436 passes, is a rod 441 secured at its upper end to a bell crank lever 442, which bell crank lever has secured to its upper arm a key stem 443 with a shifting key 444 on it. There is a catch 445 for holding this key at its lower limit of movement, which key will force the operating lever 436 into position where its roller 438 will engage the cam 439 and be operated by said cam.

"*The ribbon operating device.*"

Mounted in front of the platen carrier are two shafts 446 and 447, each of which is supported by a bearing 448 (see Fig. 5) at its upper end, and at their lower ends by the friction collars 449 and 450, as shown in Figs. 3 and 62. Secured to the upper end of the shaft 446 is a ribbon roller 451, as shown in Fig. 43. Mounted on the shaft 447 is a ribbon roller 452. These rollers are supported in a plane substantially parallel with the bottom 10 of the machine. Connecting these rollers is a ribbon 453 having two colors, each color of the ribbon running longitudinally of it. Near each end of the ribbon there is an operating lug 454 (see Fig. 59) designed to shift the mechanism which drives these ribbon rollers, and causes them to reverse their action, so that when the ribbon has been unwound off of the roller, it will be rewound on said roller. This ribbon passes through guide plates 455 and 456 secured to the rear portion of the frame 362, which hold this ribbon adjacent to the platen 392. Adjacent to the shafts 446 and 447 and extending downwardly from the top of the machine are two shafts 457 and 458, upon the upper ends of which are mounted the arms 459 and 460.

Pivotally attached to the arm 459 is an operating lever 461, having two engaging pins 462 at its outer end, between which the ribbon 453 slides until these pins are engaged by the operating lug 454 which causes the ribbon driving mechanism hereinafter described, to be reversed.

Pivotally attached to the arm 460 is an operating lever 463 having two pins 464 at its free end, between which the ribbon 453 passes until it is engaged by the lug 454 to

reverse the operation of the ribbon rollers by the mechanism hereinafter described.

The purpose of the friction clamps 449 and 450 is to hold the ribbon 453 which is being wound and unwound from the ribbon rollers taut as they are operated, and also to support the lower ends of the shafts 446 and 447 respectively.

Secured to the shaft 446, and above the friction clamp 449 is a ratchet 465 having a driving pawl 466 mounted in operative relation thereto for driving the machine 465 in the direction indicated by the arrow, shown in Fig. 63.

Feathered to the shaft 447 is a ratchet 467 having a driving pawl 468 mounted in operative relation thereto for driving the ratchet 467 in the direction indicated by the arrow, shown in Fig. 63. Pivotally connecting the driving pawls 466 and 468 is a rod 469 designed to cause said pawls to be rocked simultaneously while one of them is driving and the other is not.

Mounted on the shaft 446 is a pawl releasing dog 470 designed to engage a pin 471 on the pawl 466 and force and retain said pawl out of driving position at the proper time.

Pivotally mounted to the shaft 447 is a similar pawl releasing dog 472, designed to engage a pin 473 on the pawl 468 for holding the pawl out of driving relation with the ratchet 467 at the proper time. Connecting these pawl releasing dogs 470 and 472 is a rod 474, designed to retain one of the pawls 466 or 468 out of driving relation with its ratchet while the other of said pawls is in the driving relation therewith.

Formed integral with the pawl releasing dog 472 is an arm 475. Secured to the lower end of the shafts 457 and 458 are two arms 476 and 477. Pivotally connecting these arms 476 and 477 is a rod 478. Pivotally attached at one end to the bar 477 and pivotally and slidingly attached to the arm 475 is an operating rod 479. Connecting an arm 480 which is attached to the side 12 of the frame, with the upper end of the arm 477, is a spring 481 designed to normally hold the mechanism which drives the ratchets 465 and 466 in the position shown in Fig. 63; that is, in position where the ratchet 465 will be driven, and with it the ribbon roller 451 to draw the ribbon from the roller 452. When the lug 454 engages the pins 462 of the operating arm 461, the shaft 458 is rocked against the resistance of the spring 481 to automatically force the pawl 466 out of driving relation with the ratchet 465 and allow the pawl 468 to be forced into driving relation with the ratchet 467 for causing the ribbon roller 458 to be rotated in such a way as to wind the ribbon upon it and unwind the ribbon from the roller 451.

Pivotally attached to the arm 482, which carries the ratchet 468, is an operating rod 483 which extends from this point of attachment across to the opposite side of the machine where it is pivotally attached to the crank 484 of the crank shaft 485, as shown in Fig. 2. The lower end of the crank shaft has mounted on it a roller 486 which is in contact with the periphery of the cam 378, and is so arranged that as the cam is rotated and the projection 377 engages this roller, it rocks the shaft 485 against the resistance of the spring 487 (which spring holds this rock shaft in a normal position) and draws the rod 483 toward the left of the machine, and drives the pawls 466 and 468 for operating whichever ratchet 465 or 467 said pawls are in driving relation to for operating the proper ribbon roller 451 or 452.

"The ribbon shifting device."

Extending transversely of the machine and mounted in the sides 12 and 13 is a rock shaft 487ª which is adjacent to the lower ends of the shafts 446 and 447, as shown in Figs. 2 and 62. Connecting the friction clamps 449 and 450 with the shaft 487 are the links 488 and 489. There is a spring 490, shown in Fig. 4, for holding the rock shaft 487ª in its normal position, and the shafts 446 and 447 at their lower limits of movement. There is an arm 491 secured to the rock shaft 487ª, to the upper end of which there is pivoted an operating rod 492, and this rod is pivotally attached at its forward end to a bell crank 493, which bell crank lever is pivotally mounted on the stub shaft 494, secured to the side 13 of the frame. To the rear arm of this bell crank lever I have secured a ribbon shifting key 495, so constructed that it can be locked at its lower limit of movement. When this key is pushed downwardly, the ribbon rollers 451 and 452 are shifted upwardly, so as to bring the lower part of the ribbon 453 in line with the type on the type bars 358 through the mechanism just described, and cause the numbers to be printed in a different color from that which is commonly used. This key operated ribbon roller shifting mechanism may be connected with the subtracting lever, if desired, for being operated automatically and simultaneously with the operation of the subtracting lever for printing all numbers subtracted in different color from that color used in adding.

"The total taking mechanism."

The total taking calendar 342 has its series of notches 343 of diminishing distances from the shaft 341 for controlling the operation of the keys used in taking the total, as shown in Figs. 24 and 42. Extending transversely of the frame, and adjacent to the rear of the calculating wheel 118 is a rod support-

ing bar 496, through which a series of rods 497 extend to engage the peripheries of each of the total taking calendars 242.

Pivotally attached to the rear ends of the rods 497 is a series of arms 498 which are mounted on a shaft 499 extending transversely of the machine and mounted in the sides of the frame. Pivotally mounted on the shaft 499 and adjacent to each of the arms 498 is a locking bar 500 which has a pin 501 (see Fig. 65) near its pivotal end, designed to normally stand in engagement with a hook 502 on the adjacent arm 498. There is a spring 503 connecting the lower sides of the arm 498 and the locking bar 500 for normally holding the pin 501 against the hook 502, so that these parts will operate simultaneously in one direction.

Mounted at the outer ends of the shaft 499 and outside of the series of locking arms 500 are two shaft supporting arms 504 near the ends of the shaft 499, and outside of the series of locking arms 500, the rear ends of which are rigidly connected to an operating bar 505 which is normally held in engagement with the upper portion of each of the locking bars 500.

On the shaft 499 and in contact with the arms 504 are two arms 506, each having a hook 507 to engage a pin 508 on each of the arms 504 for causing the arms 504 to be operated simultaneously with the arms 506. The arms 506 are connected by a rod 509.

Pivotally connected to the arm 506 nearest the right side of the machine is a rod 510, which is pivotally and slidingly mounted at its forward end to a key bar 511, shown in Fig. 42, and this key bar 511 is pivotally mounted on the stub shaft 195, beneath the key-board, and secured to the right side of the machine. This key-bar has a key 513 connected with it by a key stem which extends up through the key-board.

Mounted on the forward end of the key-bar, and below its body portion is a roller 514, designed to act against the lower surface of the track 274, which is secured to the master-plate 198, as this master-plate is moved toward its forward limit of movement in taking totals. There is a spring 515 connected with the rod 510 at one end, and at its opposite end to the side 13 of the frame for normally supporting the free end of the key-bar 511 at its upper limit of movement, and also for supporting the parts attached to the shaft 499 in their normal positions.

Attached to the rear of the key bar 511 is a rod 516 (see Figs. 4, 31 and 42) which is pivotally and slidably attached at its lower end to an arm 517 which is rigidly secured to the rock shaft 52, hereinbefore described.

Extending transversely of the machine and rotatably mounted in the sides 12 and 13 below and slightly in front of the shaft 499, is a rock shaft 518. Secured near the ends of the shaft 518 are two operating arms 519 and 520, the lower ends of which are connected by a shaft 521, shown in Figs. 3 and 42. Mounted on the shaft 518, between the arms 519 and 520 is a series of bell cranks, each of which has a forward operating arm 73 which is pivotally connected with the rear end of the rod 72, and a rear toothed retaining arm 523, the teeth 524 of which are designed to be engaged by the locking bar 500 adjacent to it when the total is being taken.

Rigidly secured to the right end of the shaft 518 and outside of the arm 519 is a locking pawl 525, having a rod 526 pivotally attached to its lower end. The forward end of said rod 526 is slidably mounted in an eye support 527, secured to the rear end of the master-plate, and is so arranged that the master-plate can move freely without operating this rod, as shown in Fig. 4. There is a head 528 on the rod 526 designed to be engaged by the eye support 527 sufficiently to rock the pawl 525 very slightly on each stroke of the master-plate. When the pawl is released, the rod 526 will be moved to position where the master-plate will move it through a considerable distance for operating the parts connected with it.

Connecting the rear end of the arm 498 with the toothed retaining arm 523 is a spring 529 for drawing the parts, to which it is attached, into operative position when the totaling key is depressed.

Pivotally mounted on a stub shaft 530, secured to the side 13, is a catch 531 designed to engage the pawl 525 and hold it in normal position until released by the totaling key. This catch has pivotally attached to its lower arm a rod 532, the forward end of which rod is pivotally attached to the rod 510. There is a spring 533 connected with the forward portion of this catch 531, at one end, and at its other to the side 13 of the frame, for holding the catch in locked position against the pawl 525.

Extending transversely of the machine and immediately at the rear of the keys in the key-board and adjacent to the rear end of the locking plate 22, is a shaft 534, having a rock arm 535 at each end of it, between which rock arms the rod 536 is mounted, which rod enters a slot 537 in each of the locking plates 22, as best shown in Fig. 6.

Secured near the right end of the shaft 534 is an operating arm 538, as best shown in Fig. 31. Secured at one end to the upper portion of the operating arm 538 and at its other end to the side 13 of the frame is a spring 539. Pivotally mounted on the shaft 195 and immediately inside of the key bar 511 is a spring maintained dog 540 which is normally held against the pin 541 secured to the side 13, and against the lower portion of the

operating arm 538 by the spring 542, mounted on the shaft 195, and having its ends engage the key-bar 511 and a pin 543 on the dog 540, as shown in Fig. 31.

Rigidly secured to the shaft 534 and extending downwardly therefrom is an operating arm 544 (see Fig. 32) which engages at its lower end a pin 545 on the right side of the master-plate 199 by which it is operated as the master-plate is operated. The pin 543 is engaged by a projection 546 on the key bar 511 for throwing the dog 540 out of engagement with the operating lever 538 when the totaling key is depressed. When this key has been thus depressed, the spring 539 causes the shaft 534 to be rocked and simultaneously slides the locking plate rearwardly to move the slots in this locking plate, in which the projections 20 on the keys normally move up and down out of alinement with those projections. In this way the keys are locked at their upper limits of movement and prevented from being operated while the total is being taken.

After the total operation has been completed, the master-plate, through the lever 544 and the pin 545, causes the locking plate to be thrown to its normal position with the slots in the locking plate 22 in a line with the projections 20.

"Operation of the totaling mechanism."

In operating the machine for taking totals, the adding lever is drawn forwardly to move the master-plate 198 to its forward limit of movement. (This may be done at the time of adding the last number into the machine). When the master-plate is at its forward limit of movement, the total key 513 is depressed, thus forcing the roller 514 against the inclined face 276 (see Fig. 37) of the block 275, forcing this block rearwardly and allowing the roller to pass through an opening in the track 274 which was beneath said block and then allow the block to be moved forwardly until its under portion is engaged by said roller for holding the key in a depressed position, which causes the rod 510 to be drawn forwardly, and the forward end of the arm to be swung forwardly and the shaft 505 to be raised against resistance of the spring 515. This allows the rear ends of all of the bars 500 to be swung upwardly, and the forward end of the arms 498 to be drawn forwardly by the spring 529, thus forcing the forward ends of the rods 497 into the proper notch 343 in the calendar 342 for determining the positions of the locking bars 500 as this rod 497 limits the movements of certain of the arms, depending upon whether the particular section of the machine has any numbers calculated into it. The remainder of the bars 500 are drawn upwardly into engagement with the shaft 505

At the time the totaling key is depressed, the catch 531 is released from its engagement with the pawl 525, and at the same time the rod 516 is drawn upwardly, causing the shaft 52 to be rocked and the bars 58 to be drawn upwardly so that the hook 68 of the carriage 65 is immediately above the hook 71 on each of the key bars 28. The raising of the bars 58 also raises the bar 256 and draws the dog 258 into position where it will be depressed by the roller 253 on the forward end of the master-plate on its return stroke and be engaged by said roller on its next forward stroke.

At the time the total key 513 is depressed the pin 513′ on the forward end of the key lever 511 (see Fig. 4) engages the projection 191 on the printing key stem 187, so that the printing button is depressed for throwing the calculating mechanism out of operation and allowing the printing mechanism to be used independently of this.

When the above operations have been performed, the adding lever, which has been held at its forward limit of movement while the total key was being depressed, is released and the master-plate is drawn rearwardly by the spring 240. This causes the totaling key to be held at its lower limit of movement, as shown in Fig. 42, by its engagement with the under surface of the track 274, as the master-plate moves rearwardly. As the master-plate moves rearwardly, the shaft 518 is allowed to be rocked by the springs 529 owing to the fact that the catch 531 has already been released, and to the fact that the rod 526 is allowed to travel rearwardly with the master-plate. The toothed retaining arms 523 are drawn upwardly until the proper tooth 1^d, 2^d, 3^d, 4^d, 5^d, 6^d, 7^d, 8^d, 9^d, in each of them is engaged by one of the locking bars 500 for stopping the upward movement of the toothed retaining arm in the proper position for bringing the hook 68 of the carriage 65 into engagement with the hook 71 on the key bars which are beneath the keys corresponding to the numbers to be printed in the total.

It will be seen that owing to this construction, and owing to the construction of the calendar 342, the hooks 68 of the carriage 65 will be properly positioned relative to the hooks 71, owing to the movement of the carriage in the channel 59, by the rod 72 and the arm 522. When the master-plate reaches its rearward limit of movement, the totaling key 513 is released, owing to the fact that the track 274 is drawn out of engagement with the roller 514. This allows the spring 515 to draw the rod 510 rearwardly, which causes the arm 498 to be swung rearwardly, and draws the rod 497 rearwardly out of engagement with the calendar 342 without releasing the locking bars 500 which are in engagement with the toothed retaining arm

523. The adding lever is then drawn forwardly to draw the master-plate to its forward limit of movement which causes the roller 253 to engage the rear portion of the dog 258 for forcing the bar 256 downwardly and the bar 260 upwardly and the bar 58 downwardly for drawing the key bars 28 downwardly, and set these key bars for the printing operation automatically for printing the total and carrying out the printing operation on the numbers forming the total in the same manner as if these key bars had been depressed by hand. While the master-plate is moving forwardly, a pin engages the projection 192 on the printing key, which releases it and allows it to move to its upper limit of movement, and as the master-plate moves to its rearward limit of movement and normal position, the remaining parts of the device are brought to their normal position for further use.

"Clearing the machine."

When it is desired to take the numbers which form the total out of the machine, this is done by pressing the total button downwardly and operating the subtracting lever, which causes the calculating wheels to be rotated in the subtracting direction until all of these are at their point of starting. In the latter operation, the calculating wheels are rotated, owing to the construction of the mechanism operated by the subtracting lever, while in the operation of taking the totals, the adding wheels are not operated.

The printing button in the operation of taking totals is used to throw the calculating rack out of operative relation with the calculating wheels, while in clearing the machine, this result is accomplished by the printing mechanism, owing to the fact that in the totaling operation the bar 183 is controlled to throw the operating arm 125 into the neutral position, shown in Fig. 34, while in clearing the machine, the bar 161 is used to throw the operating arm 125 into operative relation with the subtracting cam 180, and hence cause the numbers forming the total to be rotated back to their normal position.

"General operation."

From the above description of the operative relation of the parts set out, it is believed that a general statement of the operation is unnecessary, except to state in a general way that each key in each of the rows of keys forming the sections of the machine, controls the operations of adding and subtracting by positive mechanisms automatically after any given key, or a number of keys has been set. The keys in a given row regulate the calculating section corresponding with, and immediately behind said keys in a given section, and also regulate the parts of the printing mechanism, corresponding with said section.

When a key in a single section, or one key in each of a number of rows has been set to indicate the number which is to be added into the machine, the adding lever is operated to carry the amounts indicated by the keys into the calculating wheels, and print this amount through the printing mechanism. The parts of the machine are then brought to normal position automatically, and by positive mechanisms so that the danger of not clearing the machine at each operation is obviated to a very large extent.

When a number is wrongly added into the machine, this can be subtracted out by pressing the keys corresponding to the number which has been last printed, as clearly shown on the paper in the printing mechanism, and operating the subtracting lever, which reverses the operation of the machine, subtracts the number thus desired to be subtracted out, and lists this number through the mechanism described, within a separate column in a different color, or in the same column in a different color, or with an indicating mark after it to show clearly the numbers which have been thus rectified.

When the printing button is locked at its lower limit of movement, the machine will list without in any way affecting the calculating mechanism, and hence an amount which has been calculated into the machine may remain in the machine during the listing process when the printing button has been depressed. When the listing has been completed, the user of the machine may go on calculating into the machine new numbers, taking the work up where he left off prior to his listing.

In taking the totals, my machine is particularly advantageous in that it uses the key bars which correspond with the total in automatically printing this total by the use of the adding lever, and in locking the keys at their upper limits of movement while the total is being taken to prevent any errors occurring while the total is being taken, and in clearing the machine this same result is accomplished by the use of the subtracting lever in connection with the calculating mechanism.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States, therefor is—

1. In a calculating machine, a series of calculating wheels, an adding lever, a subtracting lever, means in operative relation with each of the calculating wheels, and the adding and subtracting levers for operating the calculating wheels in opposite directions.

2. In a calculating machine, a series of calculating wheels, an adding lever, a subtracting lever, and key-controlled means in

operative relation with each of the calculating wheels, and the adding and subtracting levers for operating the calculating wheels in opposite directions.

3. In a calculating machine, a series of calculating wheels, an adding lever, a subtracting lever, and key controlled pin regulating means in operative relation with each of the calculating wheels, and the adding and subtracting levers for operating the calculating wheels in opposite directions.

4. In a calculating machine, a series of calculating wheels, an adding lever, a subtracting lever, means in operative relation with each of the calculating wheels, and the adding and subtracting levers for operating the calculating wheels in opposite directions, and a printing mechanism operatively connected with said means, and designed to be actuated by said means as the adding or subtracting lever is operated.

5. In a calculating machine, a series of calculating wheels, an adding lever, a subtracting lever, key controlled means in operative relation with each of the calculating wheels, and the adding and subtracting levers for operating the calculating wheels in opposite directions, and a printing mechanism operatively connected with said means and designed to be actuated by said means as the adding or subtracting lever is operated.

6. In a calculating machine, a series of calculating wheels, an adding lever, a subtracting lever, key controlled pin regulating means in operative relation with each of the calculating wheels, and the adding and subtracting levers for operating the calculating wheels in opposite directions, and a printing mechanism operatively connected with said means and designed to be actuated by said means as the adding or subtracting lever is operated.

7. In a calculating machine, a key-controlled calculating device, an adding and a subtracting lever for operating said calculating device to add or subtract, and a printing mechanism operatively connected with said calculating device for printing the amounts added or subtracted upon each operation of the calculating device.

8. In a calculating machine, a key-controlled calculating mechanism, an adding and a subtracting lever for operating said calculating mechanism to add or subtract, a printing mechanism operatively connected with said calculating mechanism for printing the amounts added or subtracted upon each operation of the calculating mechanism, and a totaling mechanism operatively connected with and forming a part of the calculating mechanism, designed to be operated by the adding lever.

9. In a calculating machine, a key-controlled, automatic calculating mechanism for adding or subtracting, an adding lever, a subtracting lever, operative connections between said calculating mechanism and said levers for throwing said mechanism into or out of operation, and means for automatically returning said levers and said connections to normal position after the completion of the addition or subtraction.

10. In a calculating machine, a key-controlled, automatic calculating mechanism for adding or subtracting, an adding lever, a subtracting lever, operative connections between said calculating mechanism and said levers for throwing said mechanism into and out of operation, means for automatically returning said lever and said connections to normal position after the completion of the addition or subtraction, and a printing mechanism operatively conected with the calculating mechanism for automatically printing the numbers which are added or subtracted.

11. In a calculating machine, a key-controlled printing mechanism, a calculating mechanism, means for throwing the calculating mechanism out of operation while the printing mechanism is being operated, an adding lever for operating said calculating mechanism in a positive direction, and a subtracting lever for operating said calculating mechanism in a negative direction, said adding lever being adapted to operate the printing mechanism when the calculating mechanism is thrown out of operation.

12. In a calculating machine, a series of key-sections independent of each other, a calculating section for each key section, a printing section, means operatively connected with the calculating sections and controlled by the keys in the key sections for automatically actuating the calculating sections, and a pair of levers for setting said actuating means into operation to actuate the calculating sections in the adding or subtracting direction.

13. In a calculating machine, a frame, a series of key sections removably mounted in the forward position of the frame, a series of calculating sections mounted at the rear of the key sections and above the same, means set by one of the keys in certain of the key sections for automatically operating calculating sections for adding or subtracting, an adding lever, a subtracting lever, and operative connections between said levers and said operating means.

14. In a calculating machine, a frame, a series of key sections removably mounted in the forward portion of the frame, a series of calculating sections mounted at the rear of the key sections and above the same, means set by one of the keys in certain of the key sections for automatically operating the calculating sections for adding or subtracting, an adding lever, a subtracting le-

ver, operative connections between said levers and said operating means, and a printing mechanism operatively connected with said first mentioned means and designed to operate simultaneously therewith.

15. In a calculating machine, a series of calculating mechanisms, a calculating wheel in each of the calculating mechanisms, racks designed to be thrown into or out of engagement with the calculating wheels, a series of rows of keys, each of the keys in each row of keys designed to control the action of the calculating mechanism, an adding and a subtracting lever for operating the rack vertically to co-act with the calculating wheels for adding and subtracting.

16. In a calculating machine, a series of calculating mechanisms, a calculating wheel in each of the calculating mechanisms, racks designed to be thrown into or out of engagement with the calculating wheels, a series of rows of keys, each of the keys in each row of keys designed to control the action of the calculating mechanism, an adding and a subtracting lever for operating the rack vertically to co-act with the calculating wheels for adding and subtracting, and means set by each of the keys as they are depressed for locking the other keys in the same key section out of operation until the depressed key has been returned to its normal position.

17. In a calculating machine, a series of calculating mechanisms, a calculating wheel in each of the calculating mechanisms, racks designed to be thrown into or out of engagement with the calculating wheels, a series of rows of keys, each of the keys in each row of keys designed to control the action of the calculating mechanism, an adding and a subtracting lever for operating the rack vertically to co-act with the calculating wheels for adding and subtracting, and spring means for returning the keys to their normal position.

18. In a calculating machine, a series of calculating mechanisms, a calculating wheel in each of the calculating mechanisms, racks designed to be thrown into or out of engagement with the calculating wheels, a series of rows of keys, each of the keys in each row of keys designed to control the action of the calculating mechanism, an adding and a subtracting lever for operating the rack vertically to co-act with the calculating wheels for adding and subtracting, spring means for returning the keys to their normal position, and positive means supplementing the spring means for returning the keys to their normal position.

19. In a calculating machine, a series of calculating mechanisms, a calculating wheel in each of the calculating mechanisms, racks designed to be thrown into or out of engagement with the calculating wheels, a series of rows of keys, each of the keys in each row of keys designed to control the action of the calculating mechanisms, an adding and a subtracting lever for operating the rack vertically to co-act with the calculating wheels for adding and subtracting, means set by each of the keys as they are depressed for locking the other keys in the same key section out of operation until the depressed key has been returned to its normal position, and spring means for returning the keys to their normal position.

20. In a calculating machine, a series of calculating mechanism, a calculating wheel in each of the calculating mechanisms, racks designed to be thrown into or out of engagement with the calculating wheels, a series of rows of keys, each of the keys in each row of keys designed to control the action of the calculating mechanism, an adding and a subtracting lever for operating the rack vertically to co-act with the calculating wheels for adding and subtracting, spring means for returning the keys to their normal position, and positive means supplementing the spring means for returning the keys to their normal position.

21. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, a calculating rack for each of the calculating wheels, and pin regulated means for driving the rack vertically for rotating the calculating wheels in either direction.

22. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, a calculating rack for each of the calculating wheels, pin regulated means for driving the rack vertically for rotating the calculating wheels in either direction, and keys for setting the pins in the pin regulated means.

23. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, a calculating rack for each of the calculating wheels, pin regulated means for driving the rack vertically for rotating the calculating wheels in either direction, keys

for setting the pins in the pin regulated means, and a locking device actuated by each key as depressed for locking the other keys in a given section out of operation until the depressed key returns to its normal position.

24. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a pin bearing frame operatively connected with each of the racks, a series of rows of keys, the keys in which are designed to set the pins in the pin bearing frame, a safety lock device operated by depressing any key for locking the other keys out of operation after one key has been depressed or partially depressed, and means for operating the pin bearing frame.

25. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a pin bearing frame operatively designed to be automatically thrown into and out of operation with the calculating wheels, a pin bearing frame operatively connected with each of the racks, a series of rows of keys, the keys in which are designed to set the pins in the pin bearing frame, a safety lock device operated by depressing any key for locking the other keys out of operation after one key has been depressed or partially depressed, means for positively returning the keys to their normal position after the adding and subtracting has been accomplished, and means for operating the pin bearing frame.

26. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks, designed to be automatically thrown into and out of operation with the calculating wheels, a pin bearing frame operatively connected with each of the racks, a series of rows of keys, the keys in which are designed to set the pins in the pin bearing frame, means for operating the pin bearing frame, and a master-plate operatively connected with the racks and with the pin bearing frames, springs connected with the master-plate, an adding and a subtracting lever for drawing the master-plate to its forward limit of movement and placing the springs under tension for operating the rack and the pin bearing frames, and the parts connected therewith.

27. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks, designed to be automatically thrown into and out of operation with the calculating wheels, a pin bearing frame operatively connected with each of the racks, a series of rows of keys, the keys in which are designed to set the pins in the pin bearing frame, means for operating the pin bearing frame, a master-plate operatively connected with the racks and with the pin bearing frames, springs connected with the master-plate, an adding and a subtracting lever for drawing the master-plate to its forward limit of movement and placing the springs under tension for operating the rack and the pin bearing frame, and the parts connected therewith, and a printing mechanism operatively connected with the pin bearing frame.

28. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks, designed to be automatically thrown into and out of operation with the calculating wheels, a pin bearing frame operatively connected with each of the racks, a series of rows of keys, the keys in which are designed to set the pins in the pin bearing frame, means for operating the pin bearing frame, a master-plate operatively connected with the racks and with the pin bearing frames, springs connected with the master-plate, an adding and a subtracting lever for drawing the master-plate to its forward limit of movement and placing the springs under tension for operating the rack and the pin bearing frame, and the parts connected therewith, a printing mechanism connected with the pin bearing frame, and means for throwing the rack out of operative relation with the parts of the calculating wheels while the printing mechanism is being operated.

29. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, and an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks.

30. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate,

and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, and means for setting the pins in the pin bearing frame to control the operation of the racks.

31. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, and a series of keys having means connected therewith for setting the pins in the pin bearing frames.

32. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, a series of keys having means connected therewith for setting the pins in the pin bearing frames, and means for locking the keys in a given row out of operation after one key has been depressed.

33. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, a series of keys having means connected therewith for setting the pins in the pin bearing frames, means for locking the keys in a given row out of operation after one key has been depressed, and means for retaining the keys at their lower limits of movement until automatically released and returned to their normal limits of movement.

34. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, a series of keys having means connected therewith for setting the pins in the pin bearing frames, and means for retaining the keys at their lower limits of movement until automatically released and returned to their normal limits of movement.

35. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, a series of keys having means connected therewith for setting the pins in the pin bearing frames, means for locking the keys in a given row out of operation after one key has been depressed, means for retaining the keys at their lower limits of movement until automatically released and returned to their normal limits of movement, and means for returning the keys to their normal limits of movement.

36. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, a series of pin bearing frames opera-

tively connected with the racks, a series of pins in each of the pin bearing frames, a series of keys having means connected therewith for setting the pins in the pin bearing frames, means for retaining the keys at their lower limits of movement until automatically released and returned to their normal limits of movement, and means for returning the keys to their normal limits of movement.

37. In a calculating machine, a printing mechanism, a master-plate operatively connected with the printing mechanism, a pin bearing frame operatively connected with the master-plate, keys for setting the pins in the pin bearing frame, an adding and a subtracting lever for drawing the master-plate to its forward limit of movement.

38. In a calculating machine, a series of key sections, at the front of the machine and removably connected with it, a series of pin controlled frames at the rear of the key sections and controlled by the keys in the key section, a series of calculating sections operatively connected with the pin bearing frames, an adding and a subtracting lever for putting said means into operation for operating the pin bearing frame, and the calculating sections into operation.

39. In a calculating machine, a series of key sections, at the front of the machine and removably connected with it, a series of pin controlled frames at the rear of the key sections and controlled by the keys in the key section, a series of calculating sections operatively connected with the pin bearing frames, an adding and a subtracting lever for putting said means into operation for operating the pin bearing frame, and the calculating sections into operation, a printing mechanism operatively connected with said means, a printing button for throwing the calculating mechanism out of operation and allowing the printing mechanism to be operated without in any way affecting the calculating operations of the machine.

40. In a calculating machine, a series of key sections, at the front of the machine and removably connected with it, a series of pin controlled frames at the rear of the key sections and controlled by the keys in the key section, a series of detachably mounted calculating sections operatively connected with the pin bearing frames, and an adding and a subtracting lever for putting said means into operation for operating the pin bearing frame, and the calculating sections into operation.

41. In a calculating machine, a series of key sections at the front of the machine and removably connected with it, a series of pin controlled frames at the rear of the key sections and controlled by the keys in the key section, a series of detachably mounted calculating sections operatively connected with the pin bearing frames, an adding and a subtracting lever for putting said means into operation for operating the pin bearing frame, and the calculating sections into operation, a printing mechanism operatively connected with said means, and a printing button for throwing the calculating mechanism out of operation and allowing the printing mechanism to be operated without in any way affecting the calculating operations of the machine.

42. In a calculating machine, a series of calculating wheels, means for rotating the calculating wheels in opposite directions, a calculating mechanism for controlling the operation of these wheels and transferring the numbers added or subtracted by the wheels from one section to an adjacent section, an adding and a subtracting lever for throwing said means into operation, and a printing mechanism operatively connected with said means and capable of being thrown into and out of operation in conjunction with, or separate and apart from the operation of the calculating wheels.

43. In a calculating machine, a series of calculating wheels, means for rotating the calculating wheels in opposite directions, a calculating mechanism for controlling the operation of these wheels and transferring the numbers added or subtracted by the wheels from one section to an adjacent section, an adding and a subtracting lever for throwing said means into operation, and a printing mechanism operatively connected with said means and capable of being thrown into and out of operation in conjunction with or separate and apart from the operation of the calculating wheels.

44. In a calculating machine, a series of calculating wheels, means for rotating the calculating wheels in opposite directions, a calculating mechanism for controlling the operation of these wheels and transferring the numbers added or subtracted by the wheels from one section to an adjacent section, an adding and a subtracting lever for throwing said means into operation, a printing mechanism operatively connected with said means and capable of being thrown into and out of operation in conjunction with, or separate and apart from the operation of the calculating wheels and keys for controlling the action of said means and regulating the rotation of the calculating wheels.

45. In a calculating machine, a calculating mechanism for adding and subtracting, an adding and a subtracting lever, each of which is designed to operate the calculating mechanism.

46. In a calculating machine, a calculating mechanism, for adding and subtracting, an adding and a subtracting lever, each of which is designed to operate the calculating mechanism, and a printing mechanism op-

eratively connected with the calculating mechanism.

47. In a calculating machine, a calculating mechanism for adding and subtracting, an adding and a subtracting lever, each of which is designed to operate the calculating mechanism, a printing mechanism operatively connected with the calculating mechanism, and means for holding the calculating mechanism out of operation during the operation of the printing mechanism.

48. In a calculating machine, a calculating mechanism for adding and subtracting, an adding and a subtracting lever, each of which is designed to operate the calculating mechanism, and means operatively connected with the adding and the subtracting lever for holding one out of operation while the other is being operated.

49. In a calculating machine, a calculating mechanism, for adding and subtracting, an adding and a subtracting lever, each of which is designed to operate the calculating mechanism, a printing mechanism operatively connected with the calculating mechanism, and means operatively connected with the adding and the subtracting lever for holding one out of operation while the other is being operated.

50. In a calculating machine, a calculating mechanism for adding and subtracting, an adding and a subtracting lever, each of which is designed to operate the calculating mechanism, a printing mechanism operatively connected with the calculating mechanism, means for holding the calculating mechanism out of operation during the operation of the printing mechanism, and means operatively connected with the adding and the subtracting lever for holding one out of operation while the other is being operated.

51. In a calculating machine, a series of calculating wheels, means for rotating the calculating wheels, means for controlling the operation of the calculating wheels, an adding lever for throwing said means into operation and causing the calculating means to add, and a subtracting lever for operating said means in such a way as to throw the adding mechanisms into subtracting positions and causing the calculating mechanism to subtract.

52. In a calculating machine, a series of rows of key bars, a printing mechanism, a calculating mechanism, means operatively connected with the calculating and printing mechanisms for drawing the key bars downwardly and causing the total of the numbers which have been calculated into the machine to be printed by the printing mechanism, and means actuated by the subtracting lever for clearing the machine and turning the calculating wheels to their zero position.

53. In a calculating machine, a series of rows of key bars, a printing mechanism, a calculating mechanism, means operatively connected with the calculating and printing mechanisms for drawing the key bars downwardly and causing the total of the numbers which have been calculated into the machine to be printed by the printing mechanism, a totaling key for throwing said means into operative position, and means actuated by the subtracting lever for clearing the machine and turning the calculating wheels to their zero position.

54. In a calculating machine, a series of rows of key bars, a printing mechanism, a calculating mechanism, means operatively connected with the calculating and printing mechanisms for drawing the key bars downwardly and causing the total of the numbers which have been calculated into the machine to be printed by the printing mechanism, a totaling key for throwing said means into operative position, an adding lever for operating said total mechanism, and means actuated by the subtracting lever for clearing the machine and turning the calculating wheels to the zero position.

55. In a calculating machine, a key controlled pin driven automatic calculating mechanism, an adding and a subtracting lever for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby the parts are returned to their normal position after the completion of the addition or subtraction, a printing mechanism operatively connected with the calculating mechanism for automatically printing the numbers which are added or subtracted, a carriage in the printing mechanism, and means for automatically shifting the carriage when the subtracting lever is operated to list the subtracted numbers in a column separate from the column used in listing the added numbers.

56. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the mater-plate to its forward limit of movement for placing the springs under tension for operating the racks, and means for regulating the operative action of the spring.

57. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and

with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, means for regulating the operative action of the spring, a series of pin bearing frames operatively connected with the racks, a series of pins in each of the pin bearing frames, and means for setting the pins in the pin bearing frame to control the operation of the racks.

58. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, means for regulating the operative action of the spring, and a series of keys having means connected therewith for setting the pins in the pin bearing frames.

59. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, means for regulating the operative action of the spring, a series of keys having means connected therewith for setting the pins in the pin bearing frame, and means for locking the keys in a given row out of operation after one key has been depressed.

60. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, means for regulating the operative action of the spring, a series of keys having means connected therewith for setting the pins in the pin bearing frames, and means for retaining the keys at their lower limits of movement until automatically released and returned to their normal limits of movements.

61. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, a calculating wheel in each calculating section, a series of racks designed to be automatically thrown into and out of operation with the calculating wheels, a master-plate, springs operatively connected with the master-plate and with the racks, an adding and a subtracting lever for moving the master-plate to its forward limit of movement for placing the springs under tension for operating the racks, means for regulating the operative action of the spring, a series of keys having means connected therewith for setting the pins in the pin bearing frames, and means for returning the keys to their normal limit of movement.

Des Moines, Iowa, March 21, 1908.

MARTIN TEETOR.

Witnesses:

S. F. Christy,

M. E. Bennett.

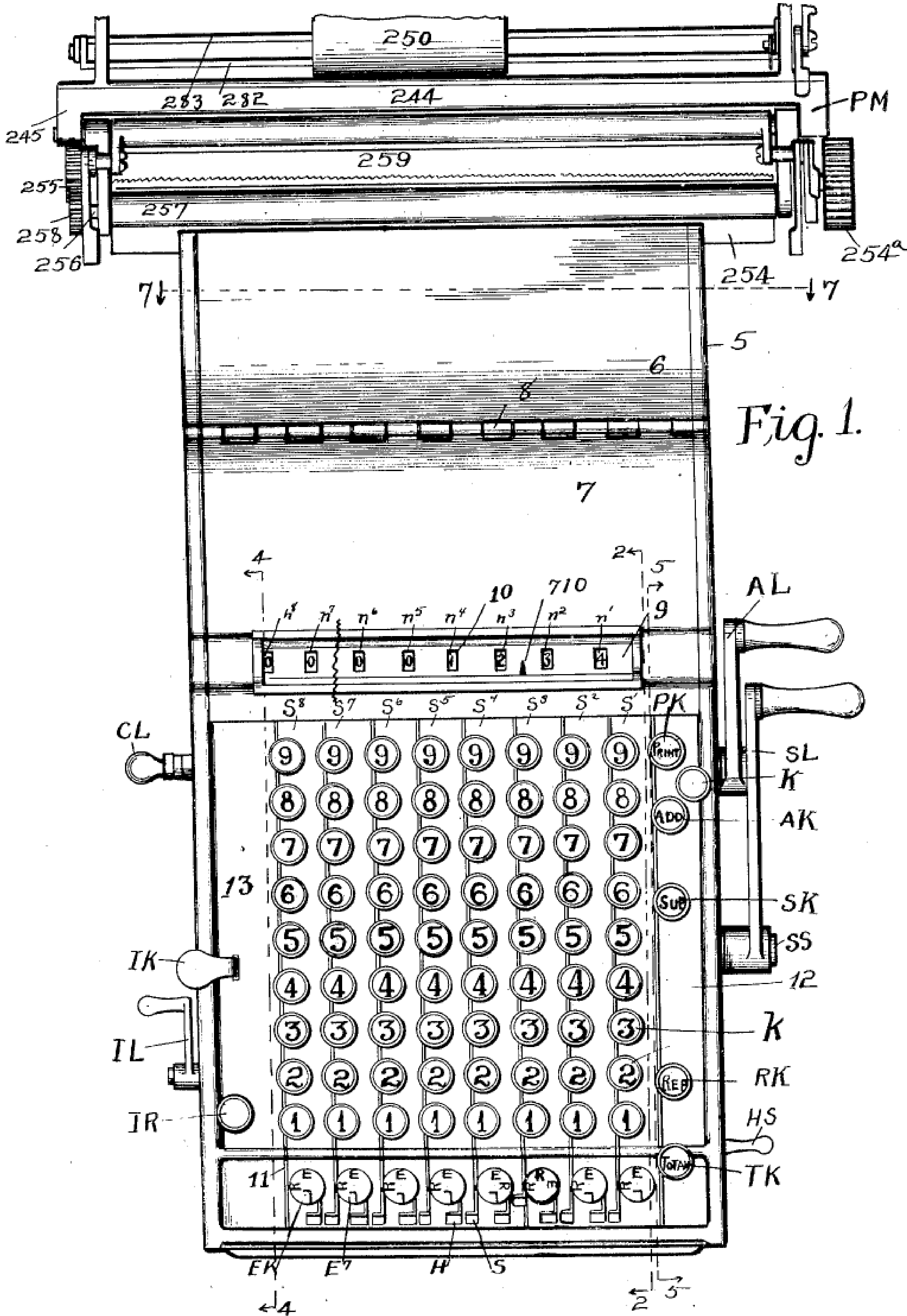
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NEXT ITEM

M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED MAR. 3, 1911.

1,344,191.

Patented June 22, 1920.
20 SHEETS—SHEET 1.



Witnesses
A. G. Hague,
A. A. Thomas

Inventor
Martin Teetor.
by Wallace R. Lane atty.

1920 06 22 US1344191 p01.png

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20 SHEETS—SHEET 2.

Fig. 11.

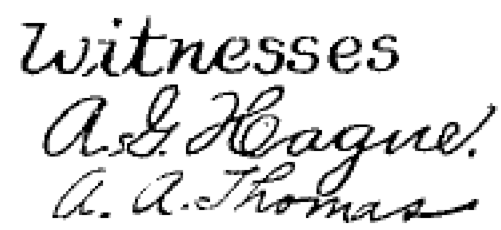
Fig. 2.

Fig. 13.

Fig. 12.

Fig. 14.

Witnesses



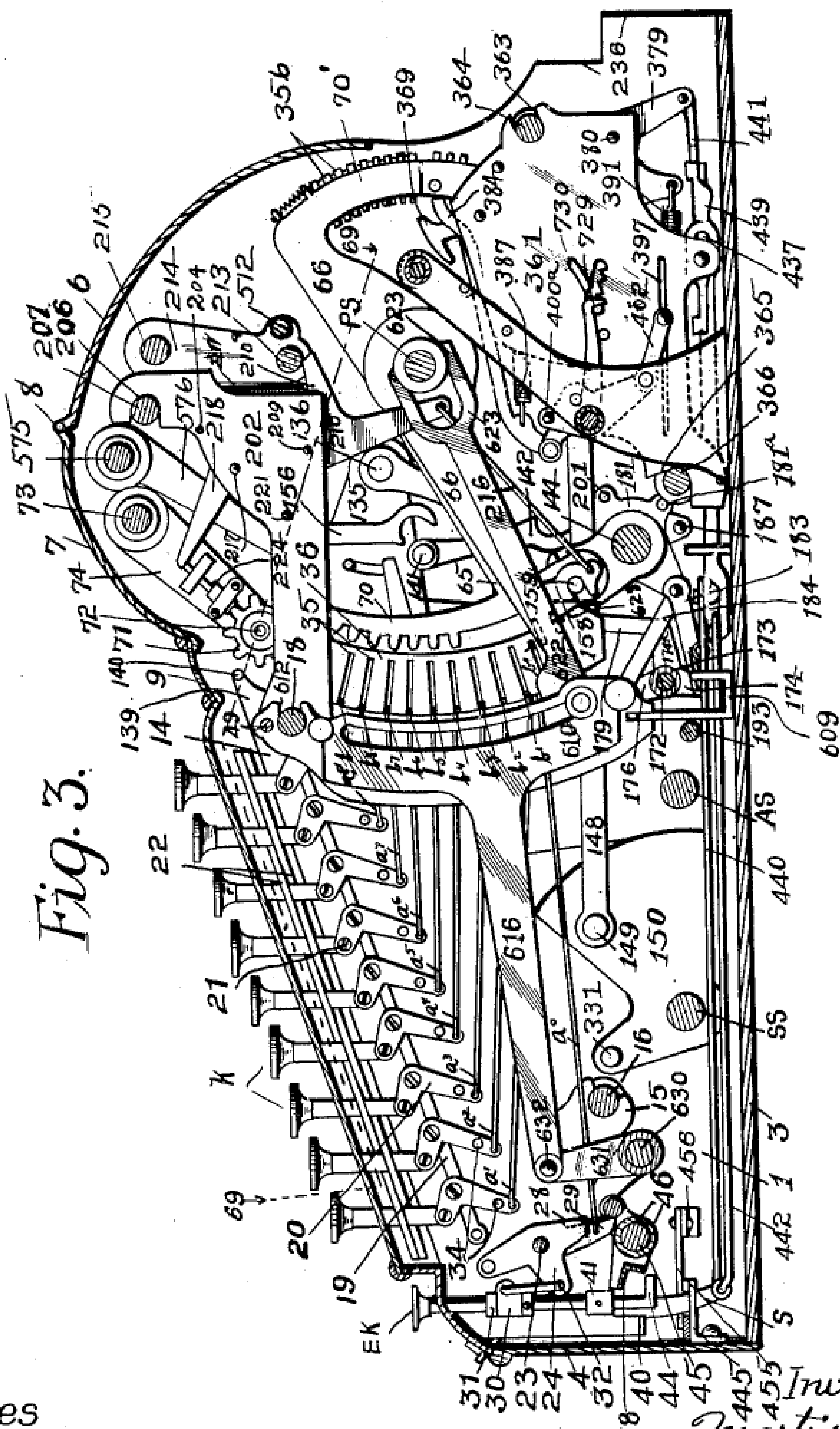
Inventor,
Martin Teetor
by Wallace R. Lane Atty

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20 SHEETS—SHEET 3.

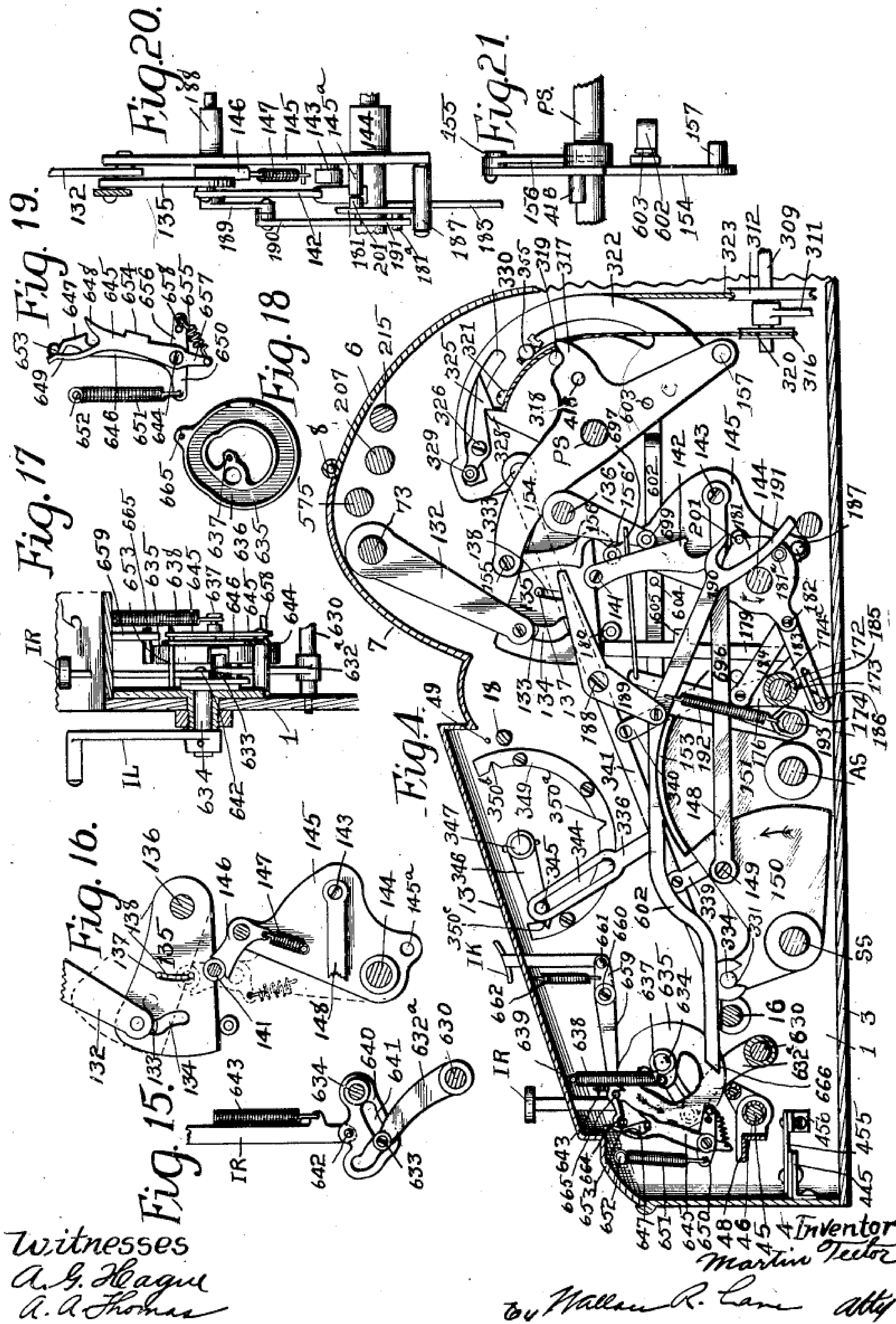


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A. A. Thomas

Inventor
Martin Teetor
by Wallace R. Lane atty

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A. A. Thomas

Inventor
Martin Teetor
by Wallace R. Lane atty

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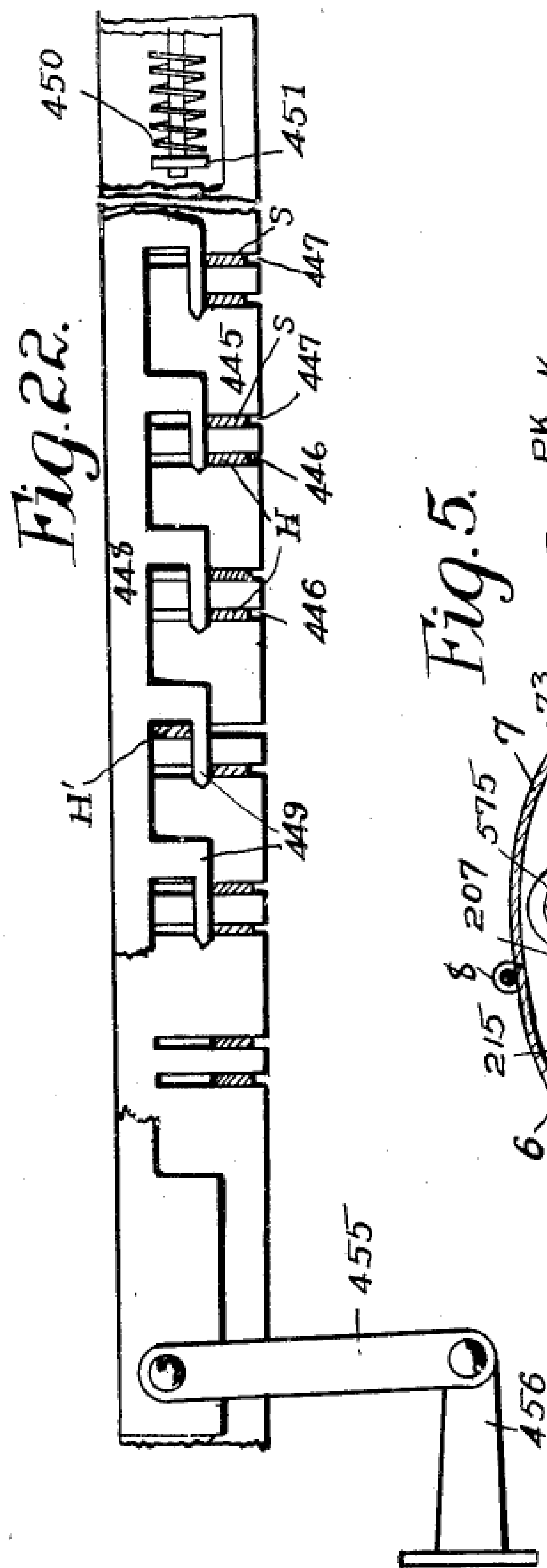
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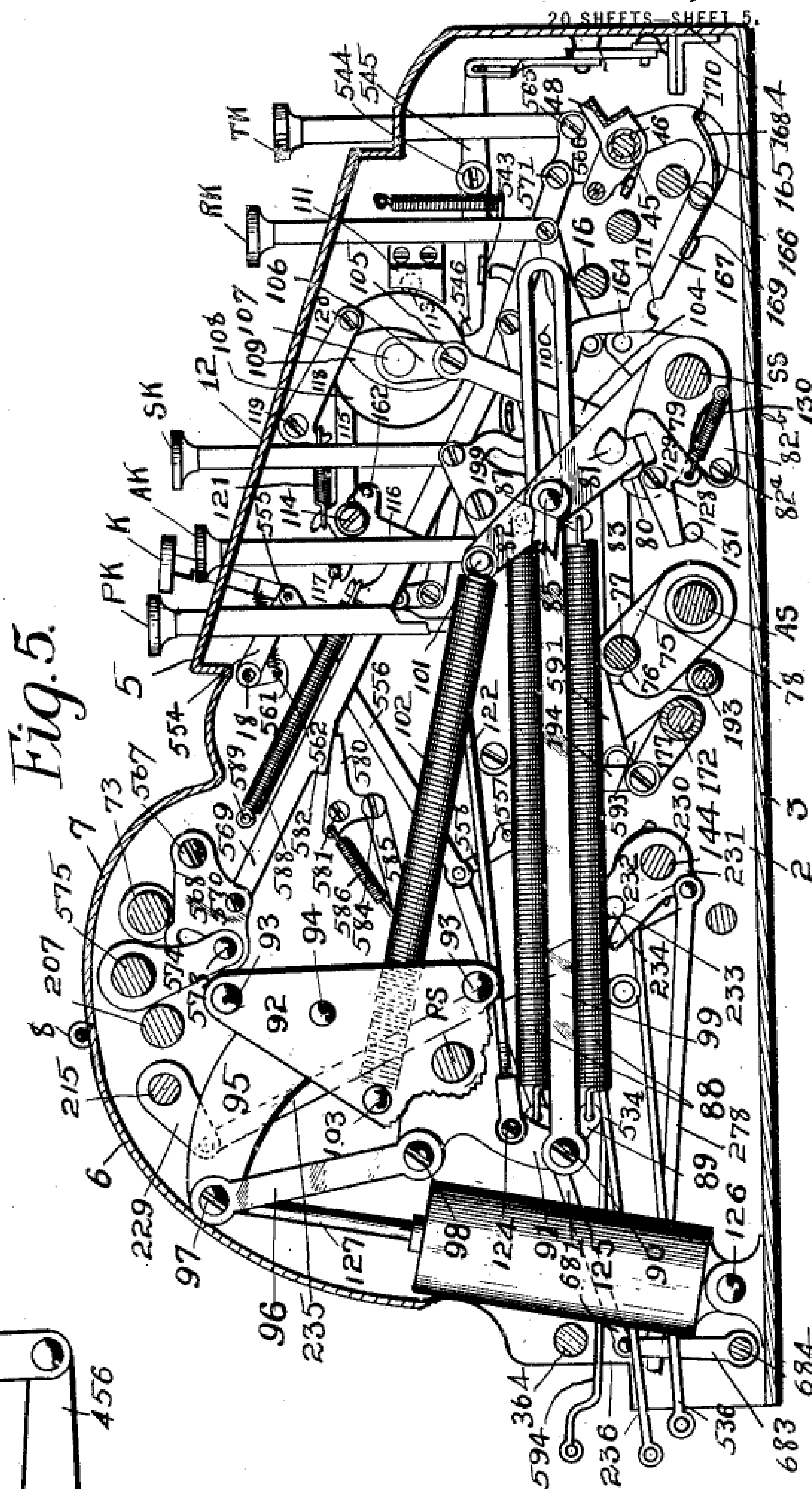
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20 SHEETS—SHEET 5.





Witnesses
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A. A. Thomas

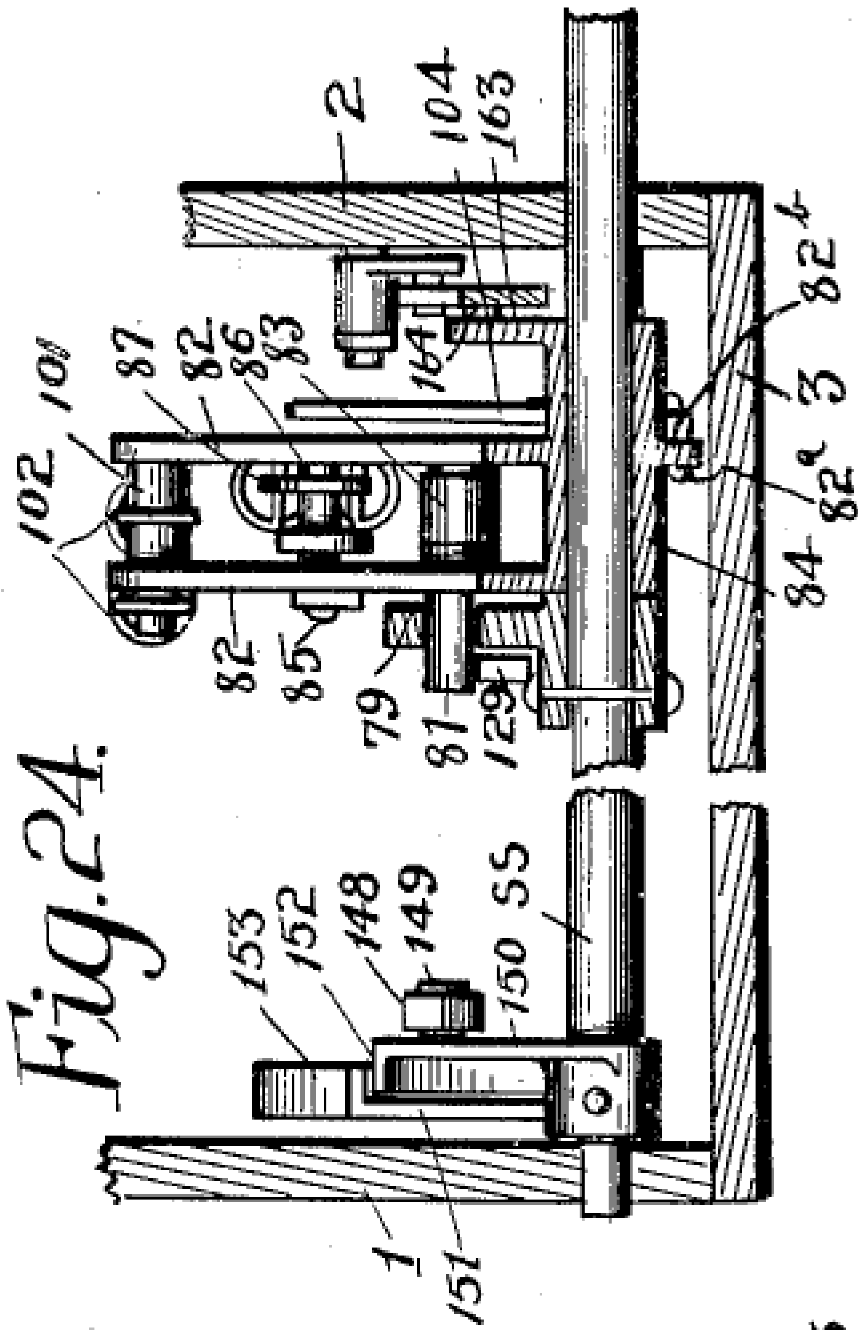
Inventor
Martin Teetor.
by Wallace R. Lane atty

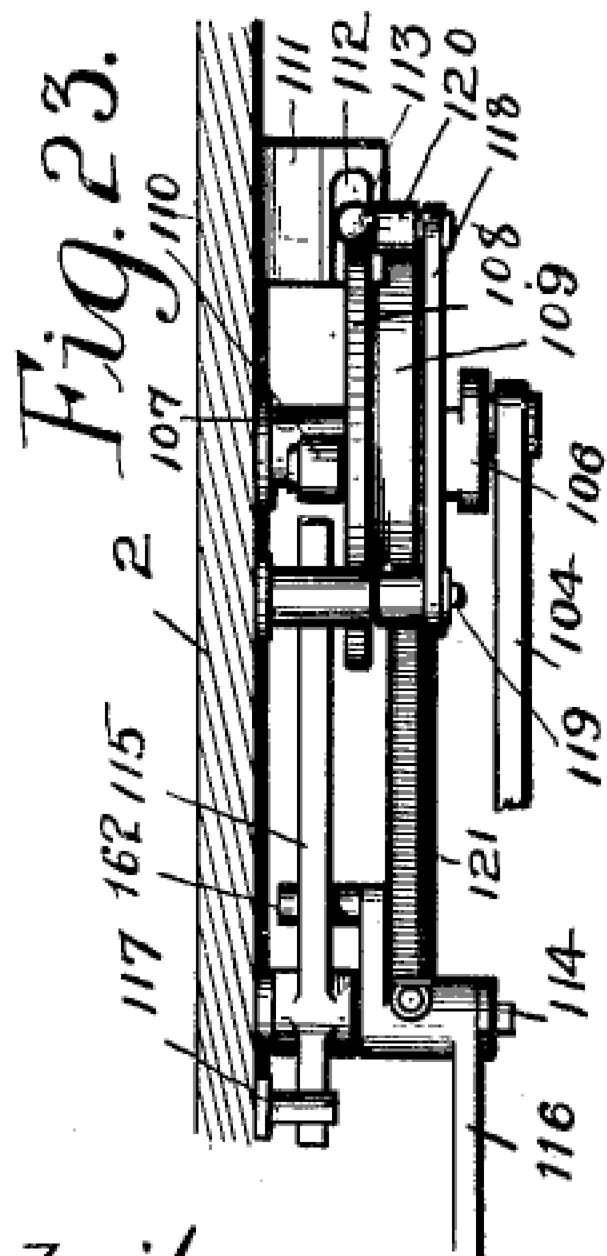
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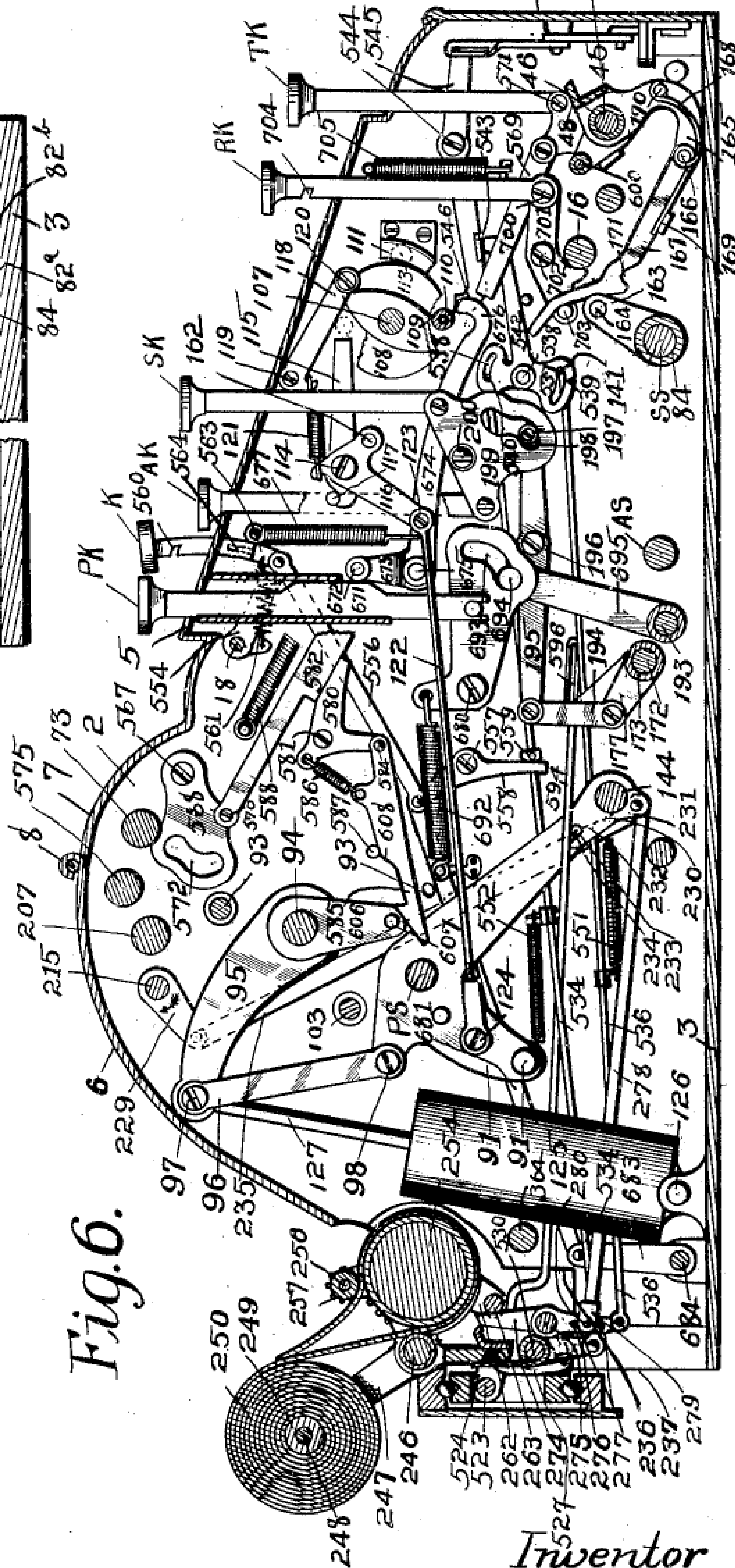
1,344,191.

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20 SHEETS—SHEET 6.


Fig. 24.


Fig. 23.


Fig. 6.

Witnesses
A. G. Hague
A. A. Thomas

Inventor
Martin Teetor.
by Wallace R. Lane atty.

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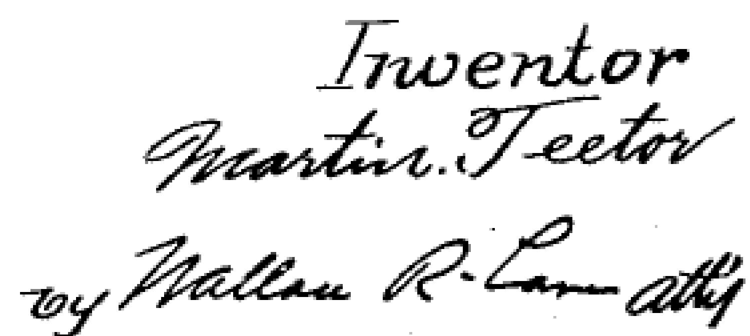
20 SHEETS—SHEET 7.

Fig. 7.

Witnesses

A. G. Hague.

A. A. Thomas

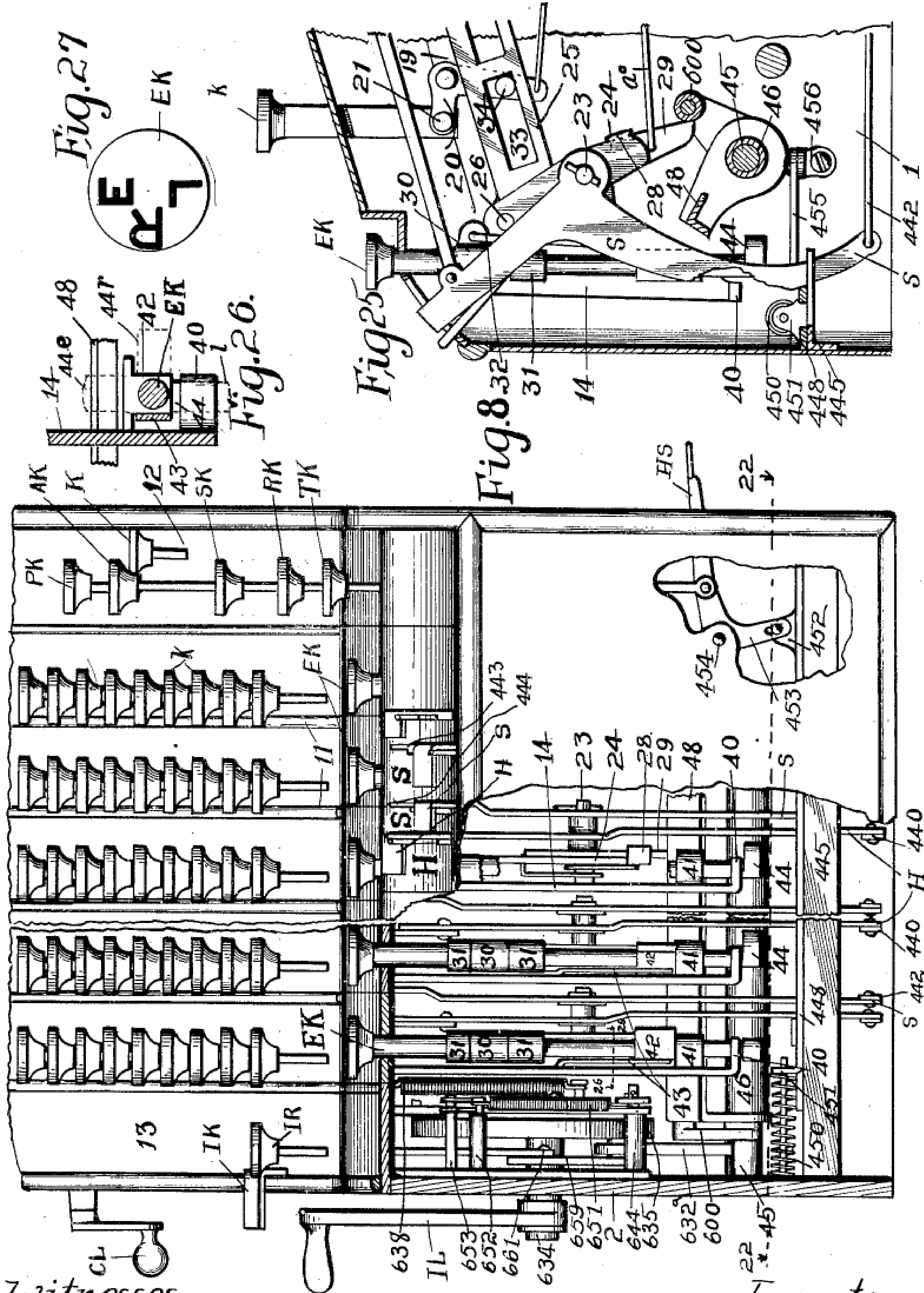


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20 SHEETS—SHEET 8.



Witnesses
A. G. Hague.
A. A. Thomas

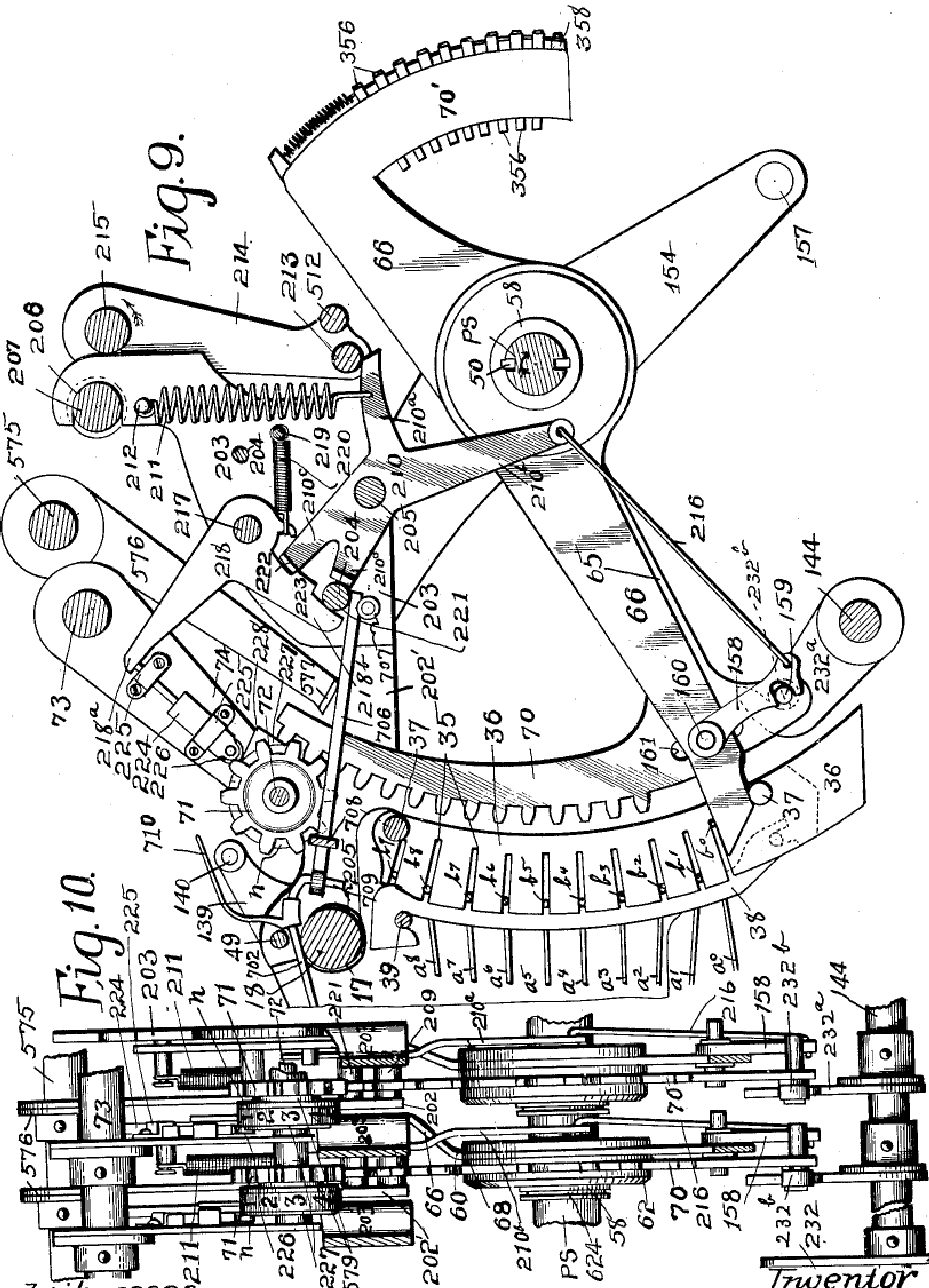
Inventor
Martin Teetor.
by Wallace R. Lane Atty.

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M. TEETOR.
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20 SHEETS—SHEET 9.



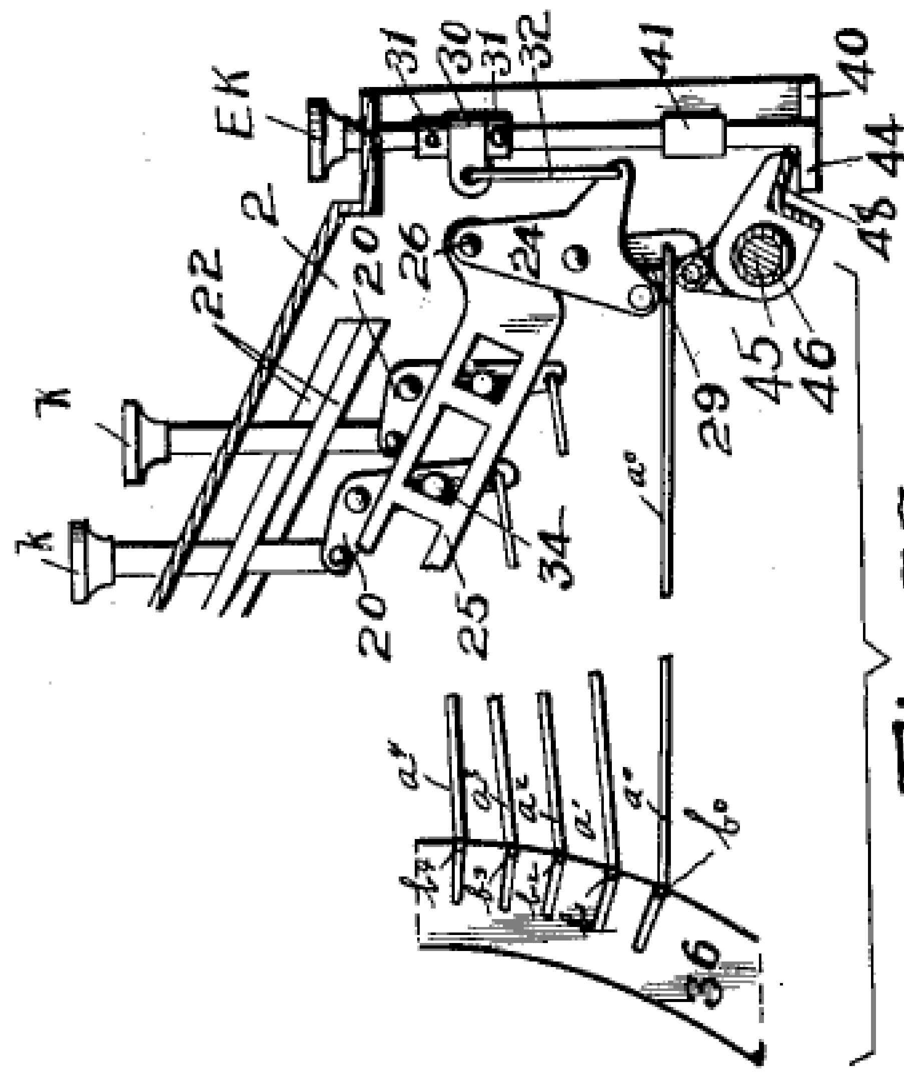
M. TEETOR.

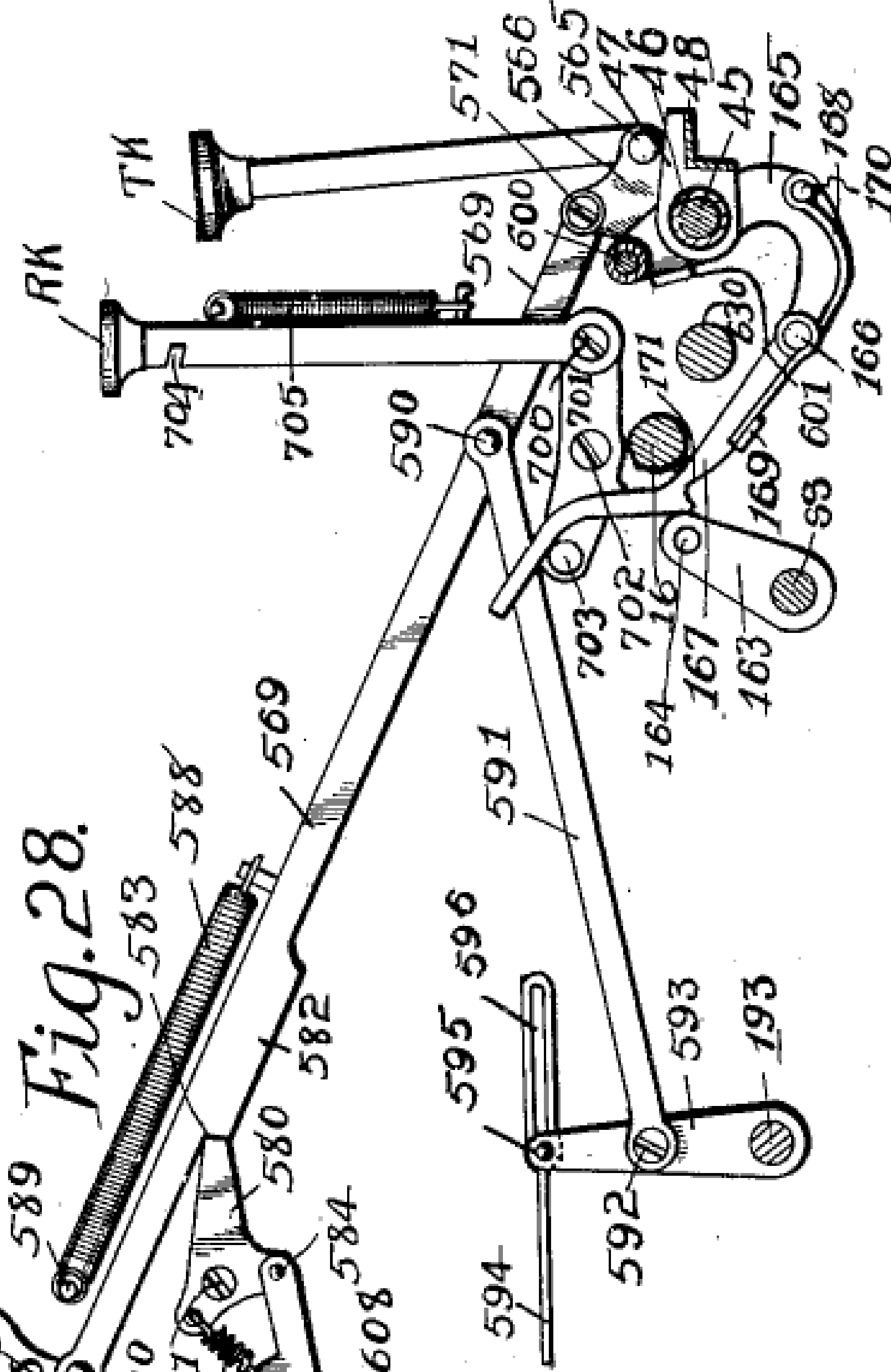
CALCULATING MACHINE.

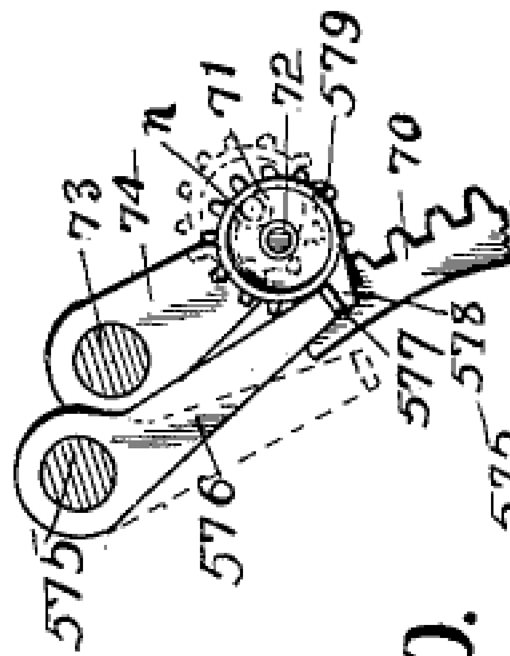
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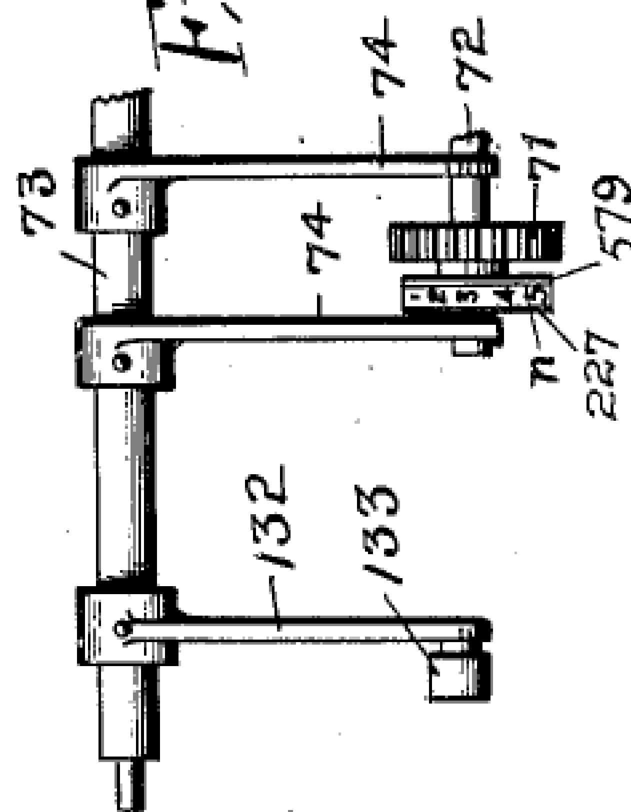
1,344,191. **Patented June 22, 1920.**

20 SHEETS—SHEET 10.









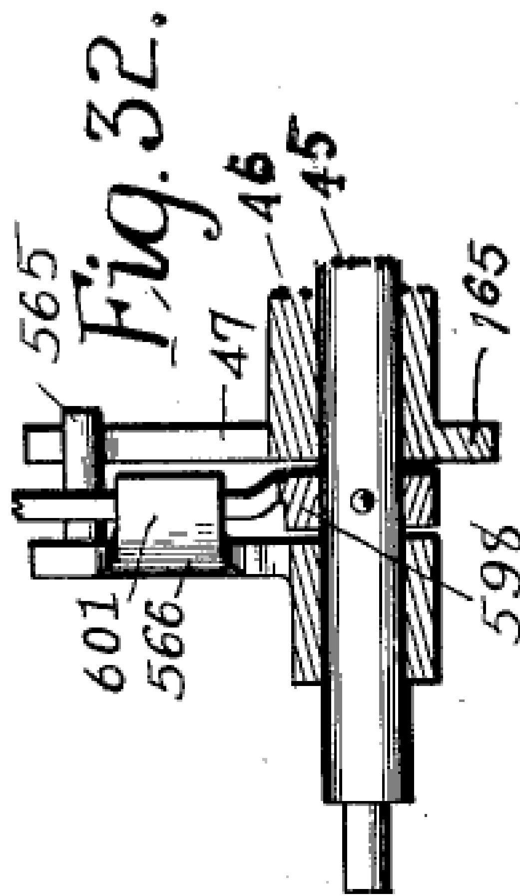


Fig.31.

Witnesses
A. G. Hague
A. A. Thomas

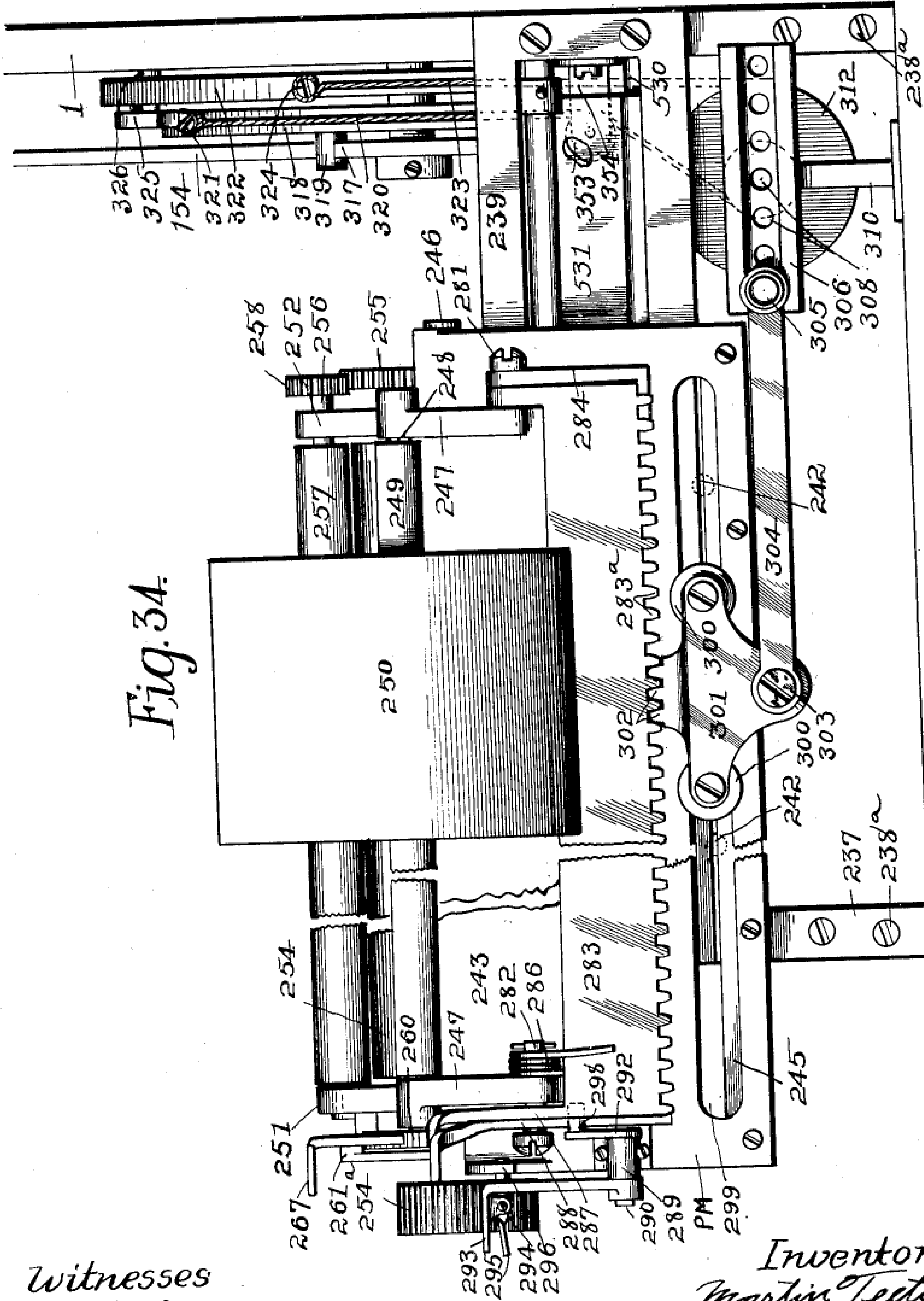
Inventor
Martin Teetor.
by Wallace R. Lane atty

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M. TEETOR.
CALCULATING MACHINE.
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20 SHEETS—SHEET 11.



Witnesses
A. G. Hague
A. A. Thomas

Inventor
Martin Teetor.
by William R. Lane Atty

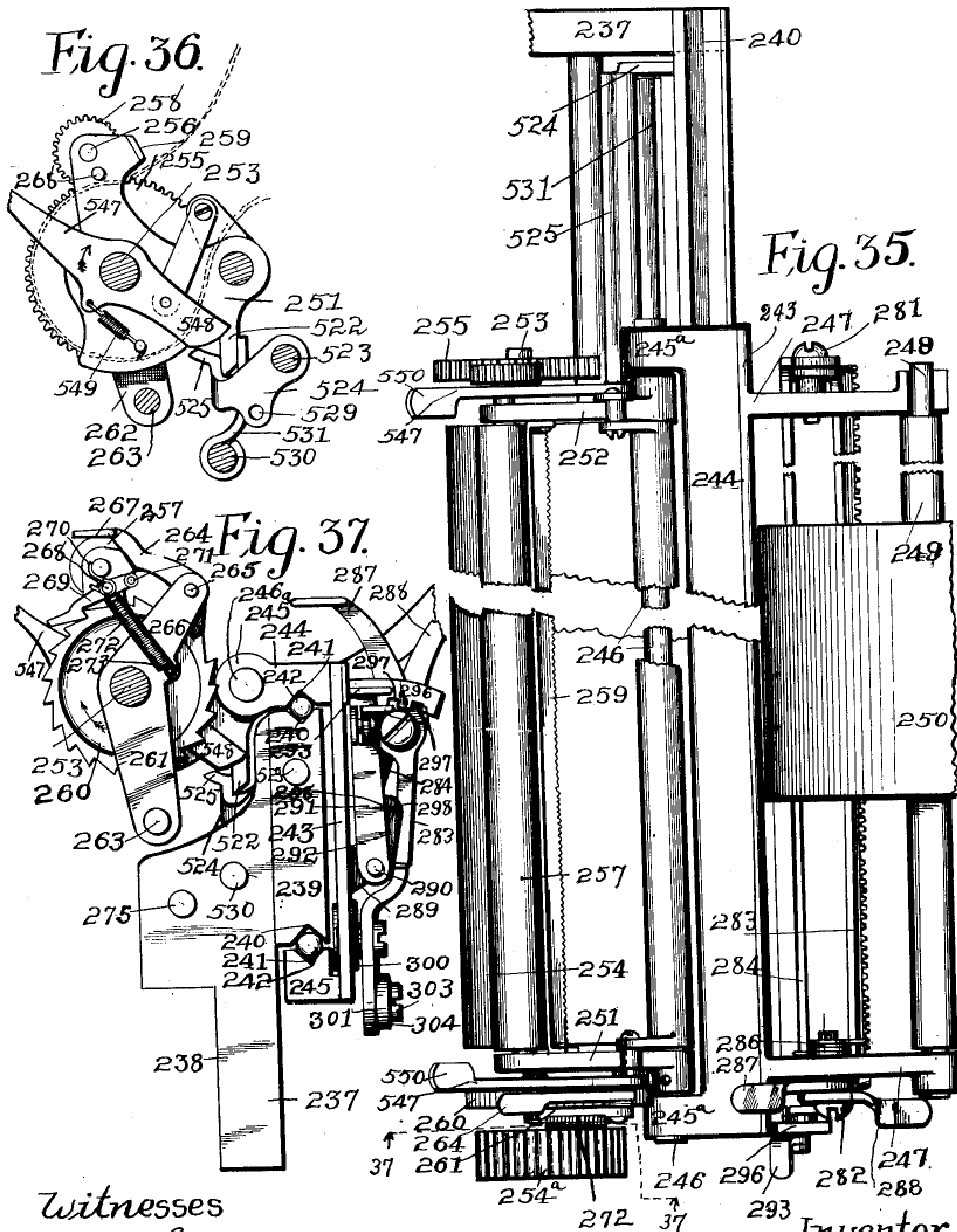
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Witnesses
A. G. Hague.
A. A. Thomas

Inventor
Martin Teetor.
by Wallace R. Lane atty

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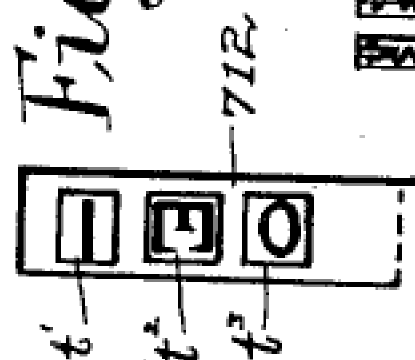
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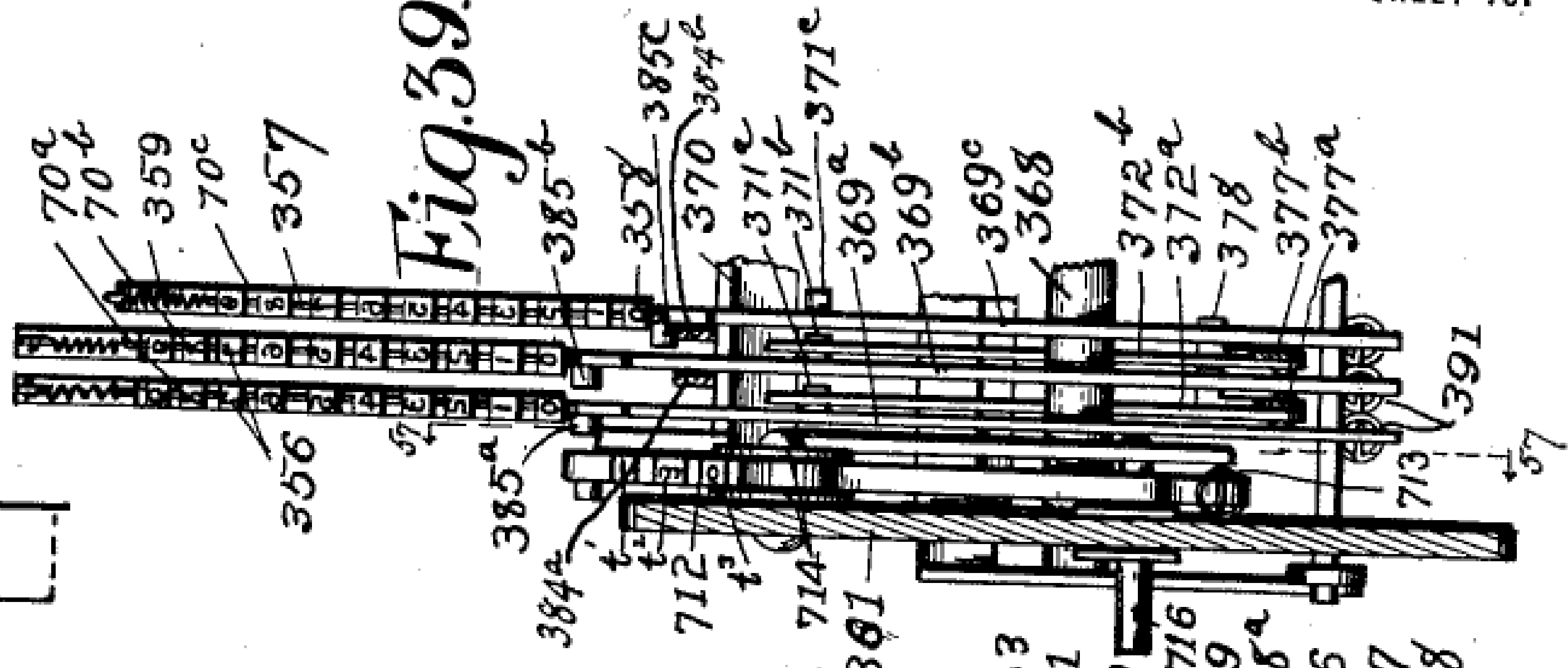
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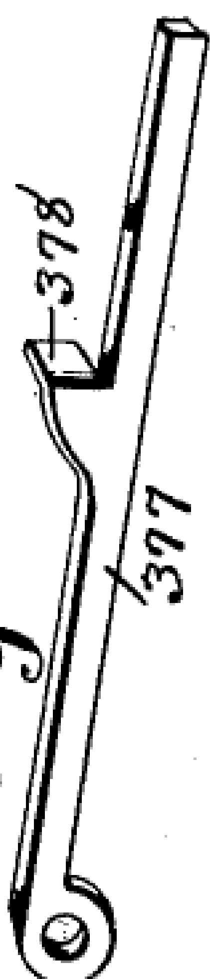
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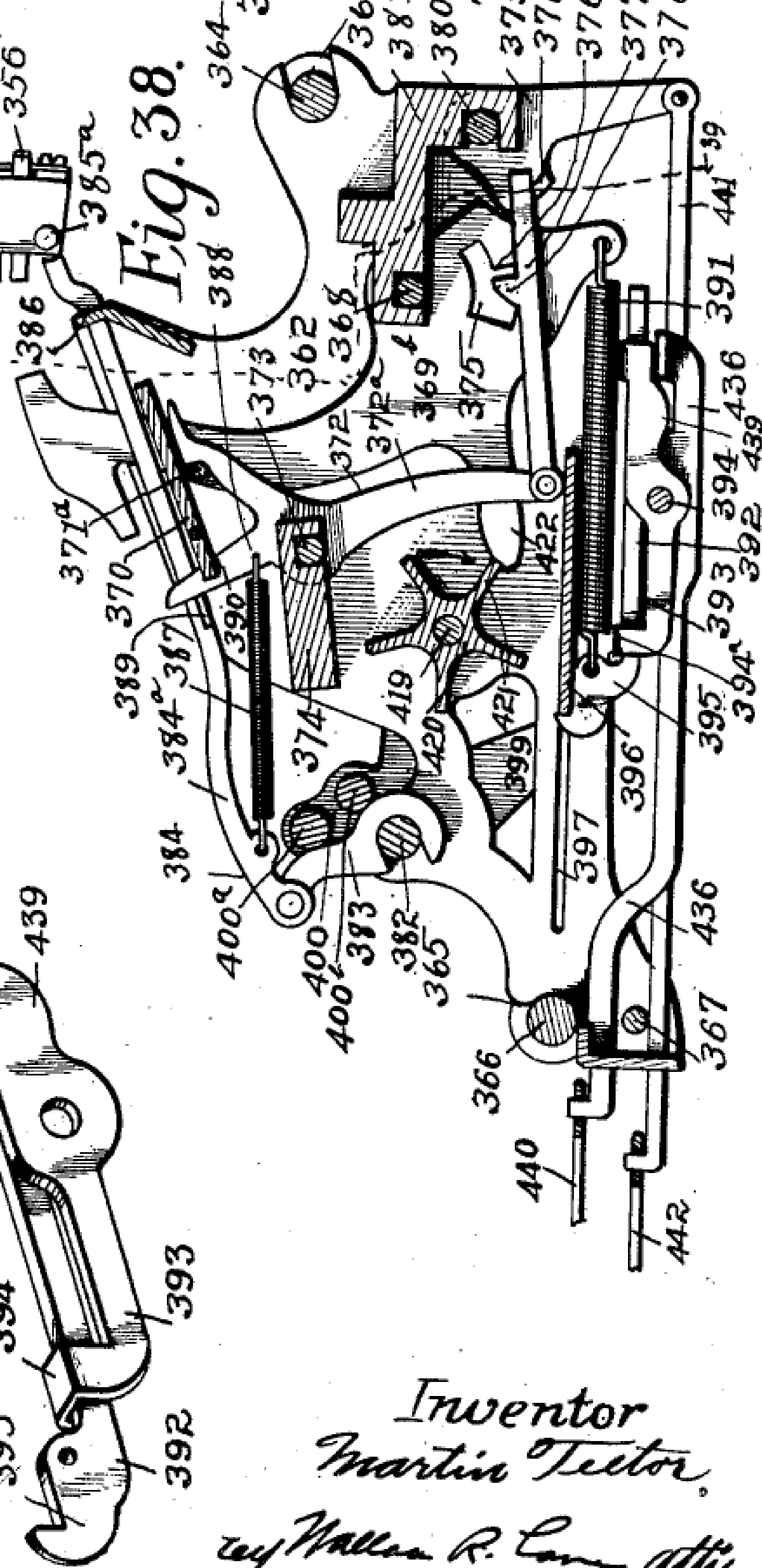
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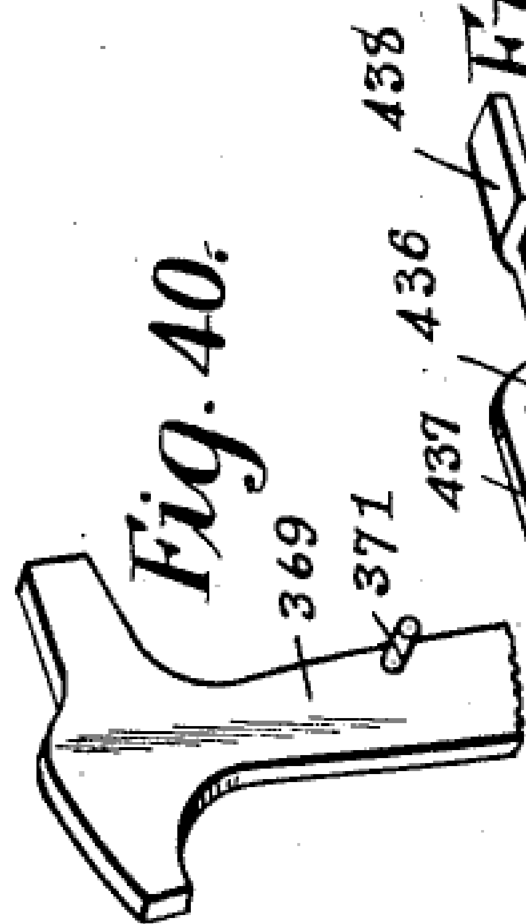
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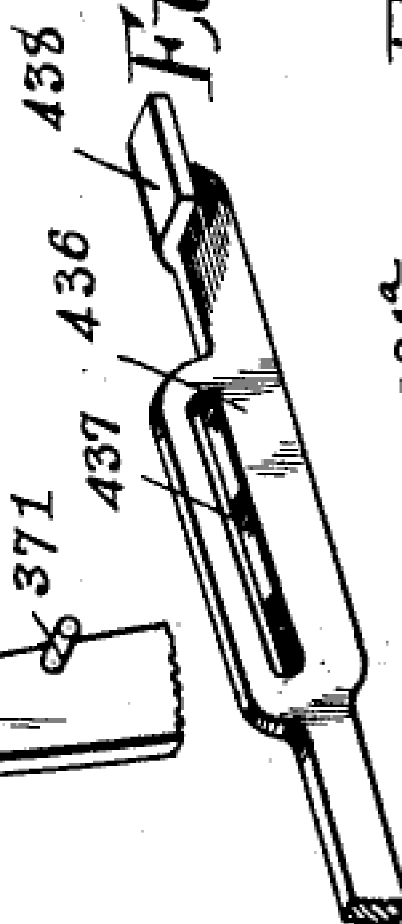


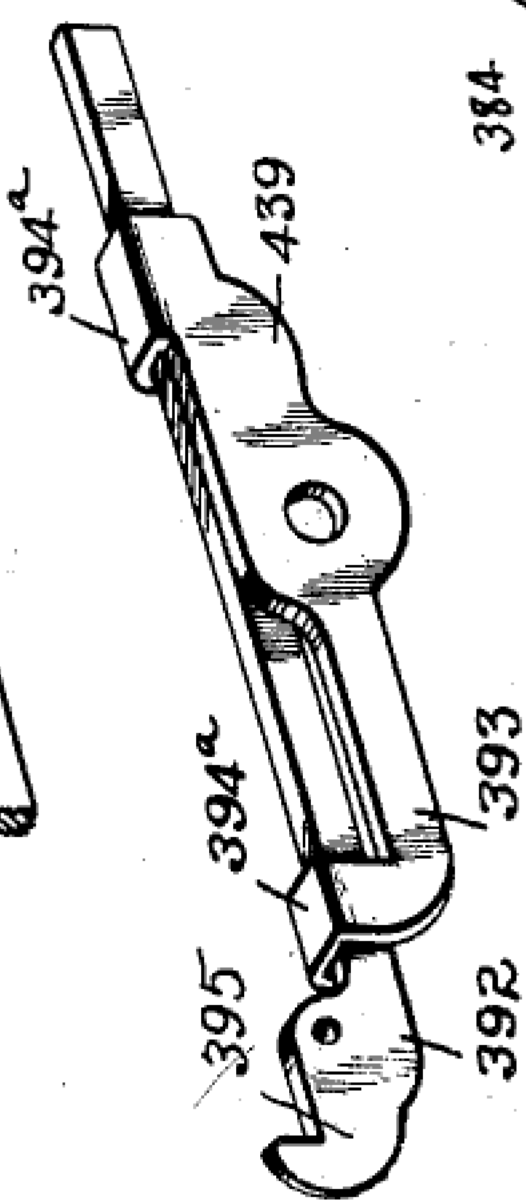












Witnesses

A. G. Hague

A. A. Thomas

Inventor

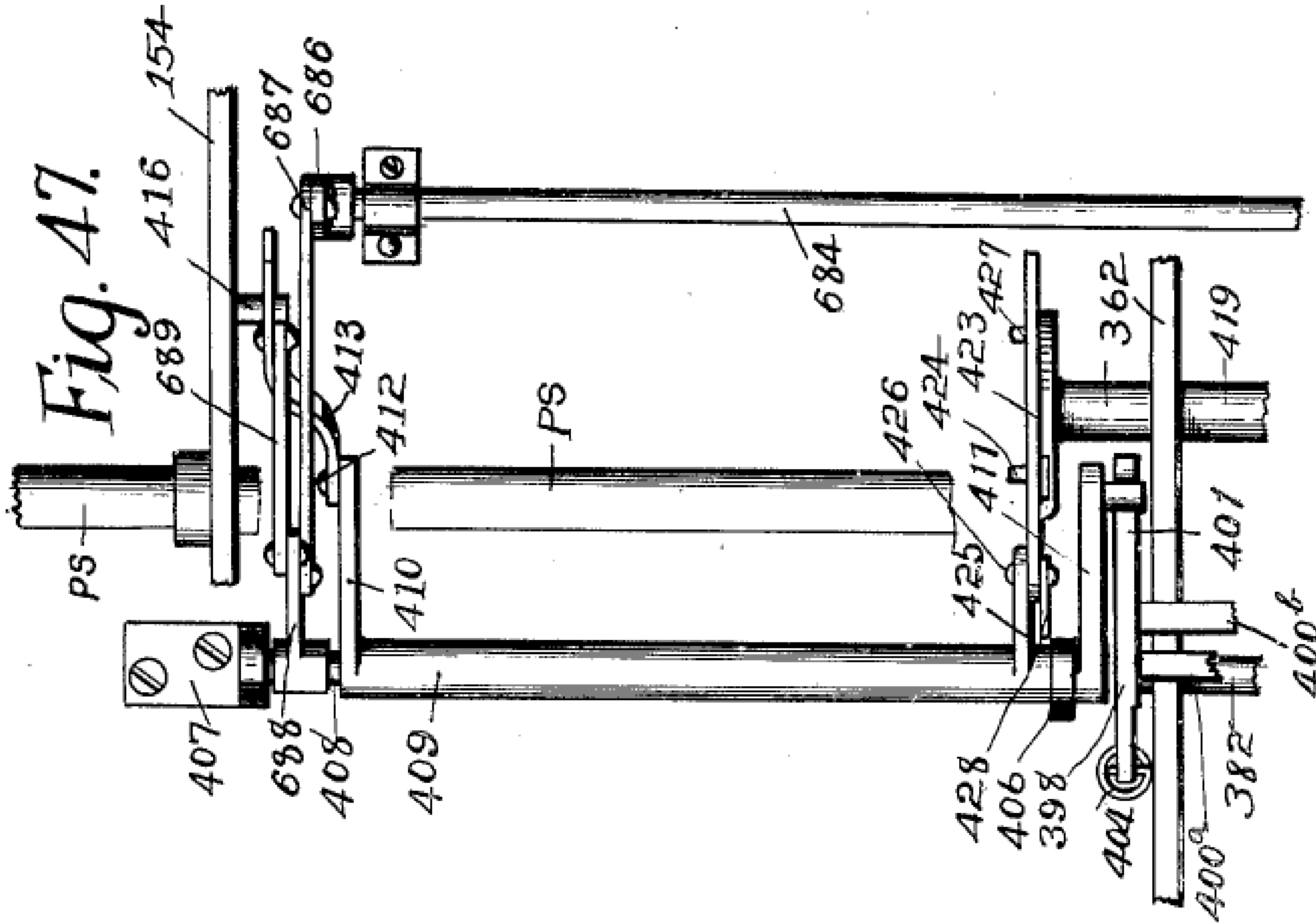
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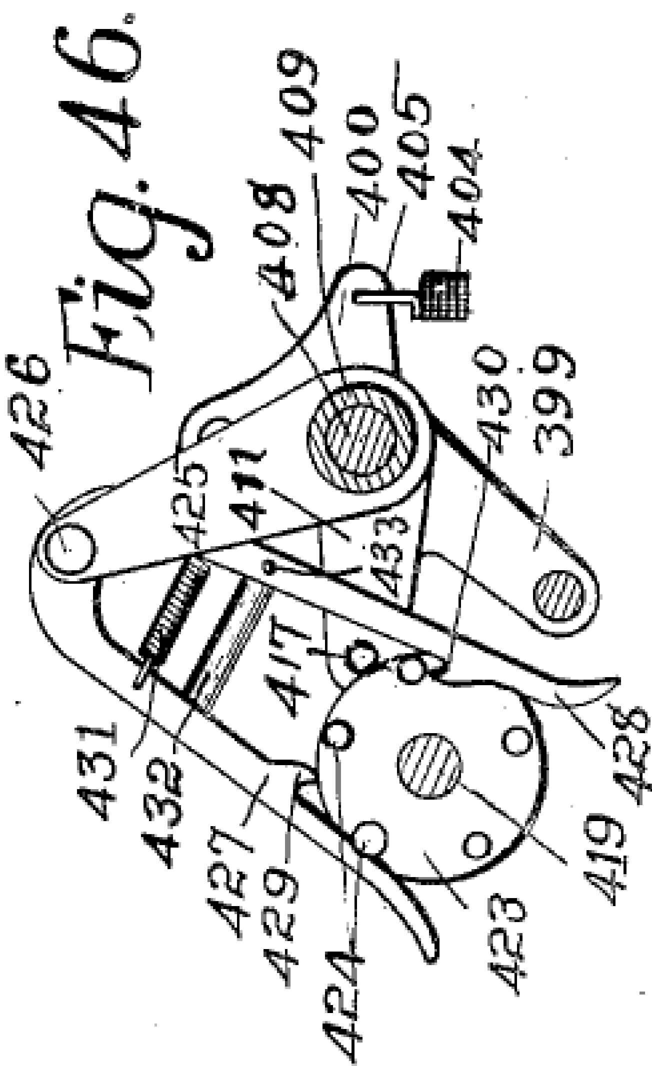
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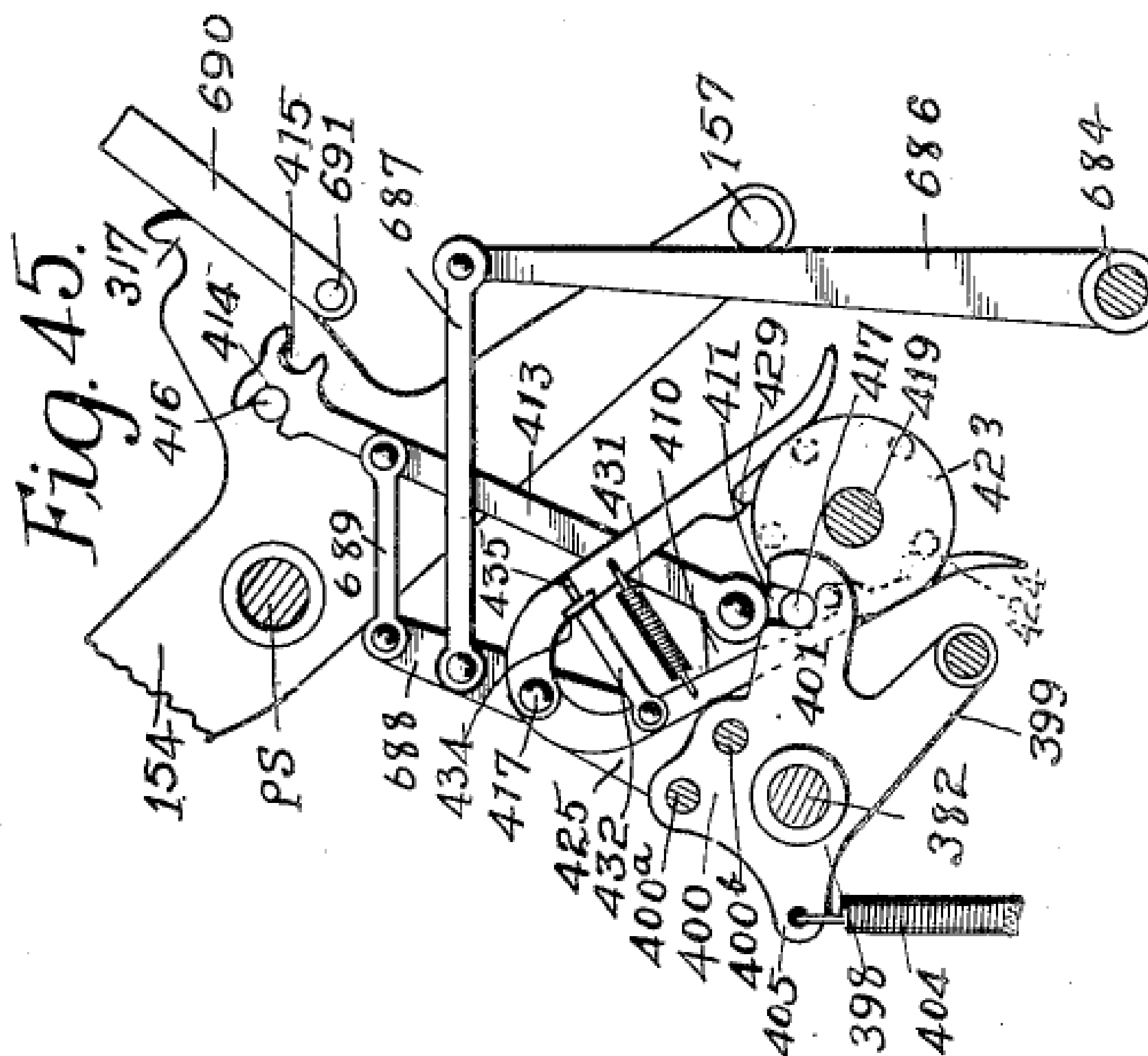
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A. G. Hague
A. A. Thomas

Inventor
Martin Teetor
by Wallace R. Lane atty

M. TEETOR.

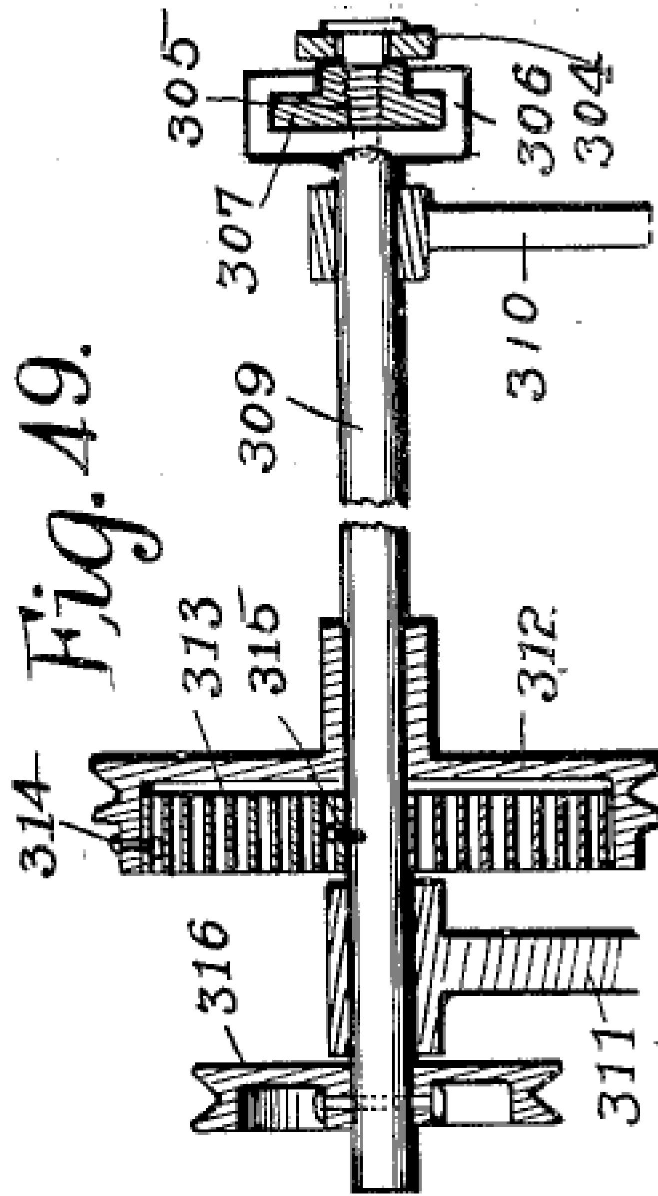
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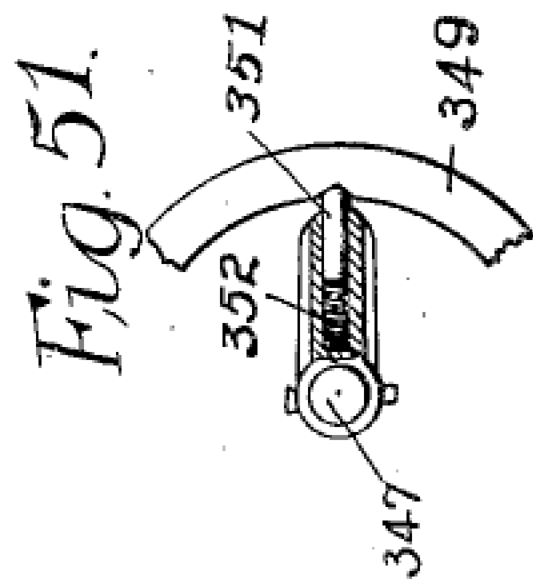
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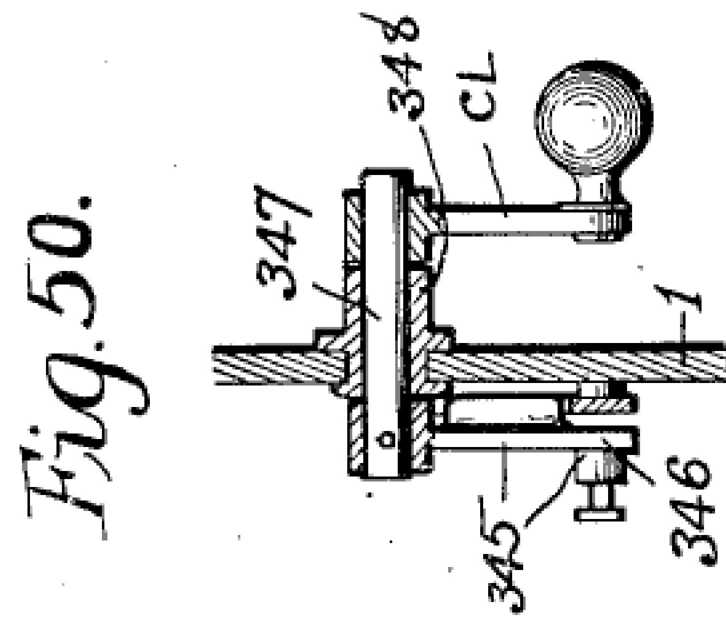
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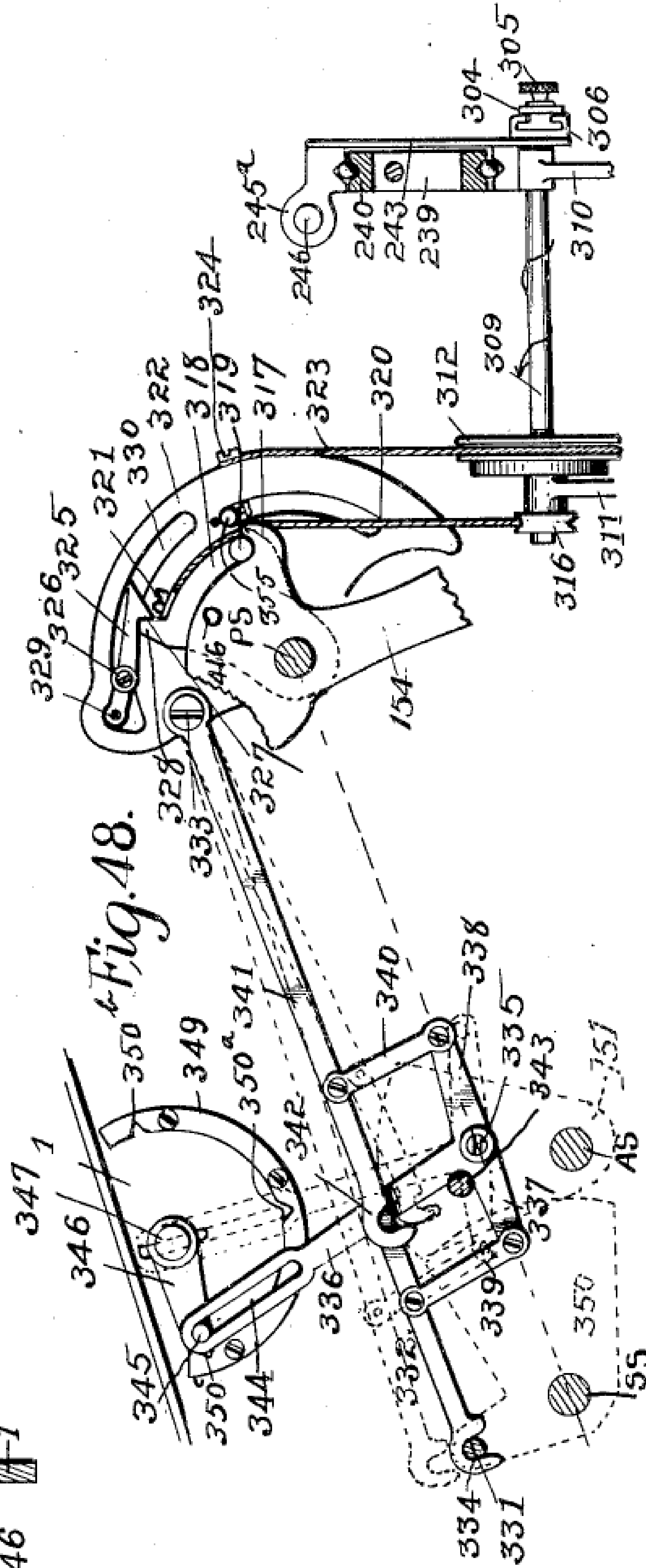
Patented June 22, 1920.

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Witnesses

A. G. Hague

A. A. Thomas

Inventor

Martin Teetor,

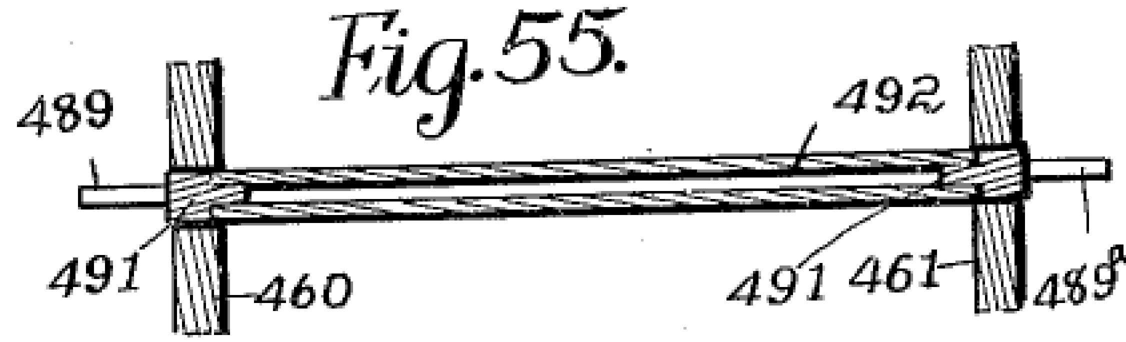
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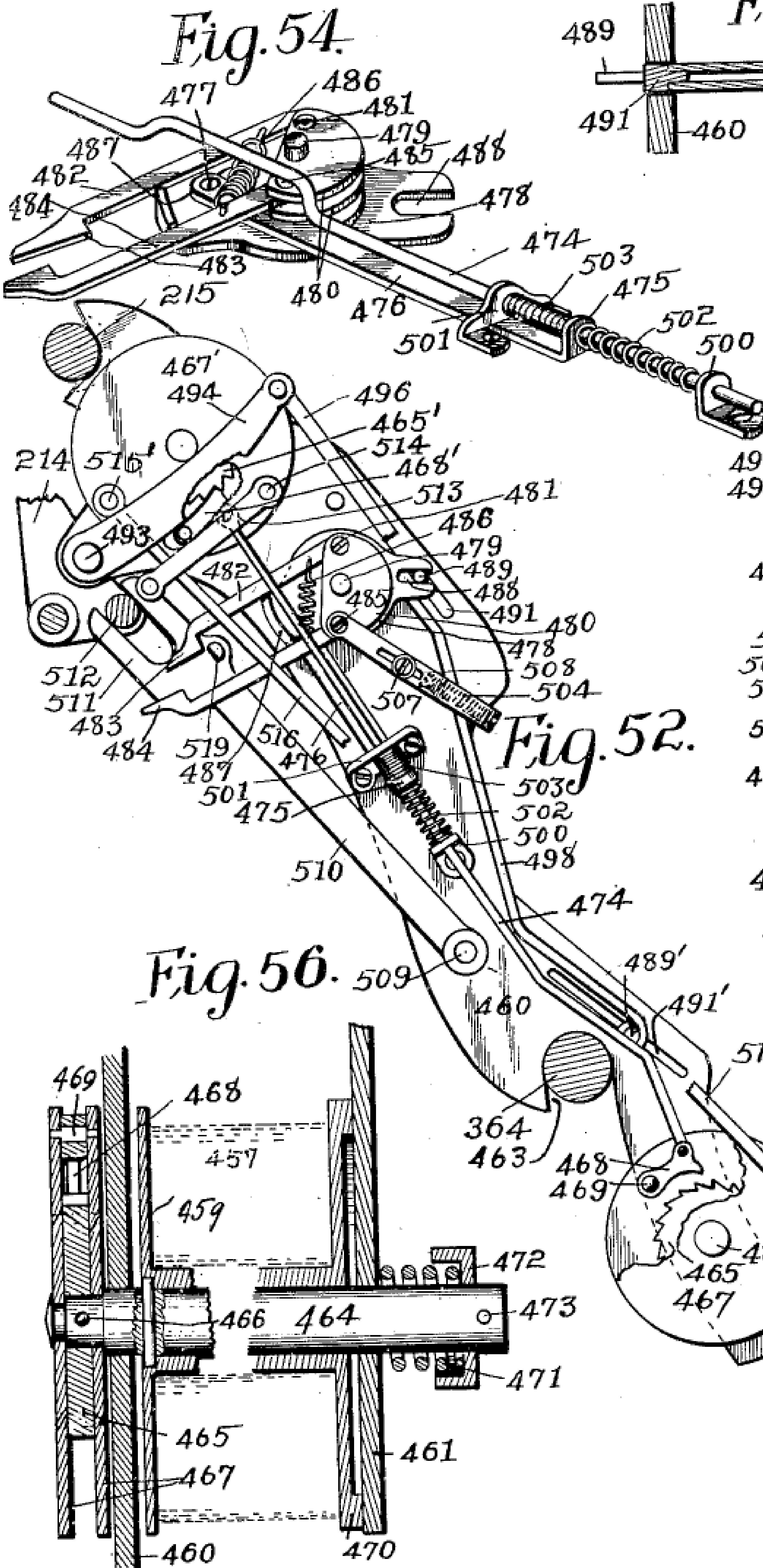
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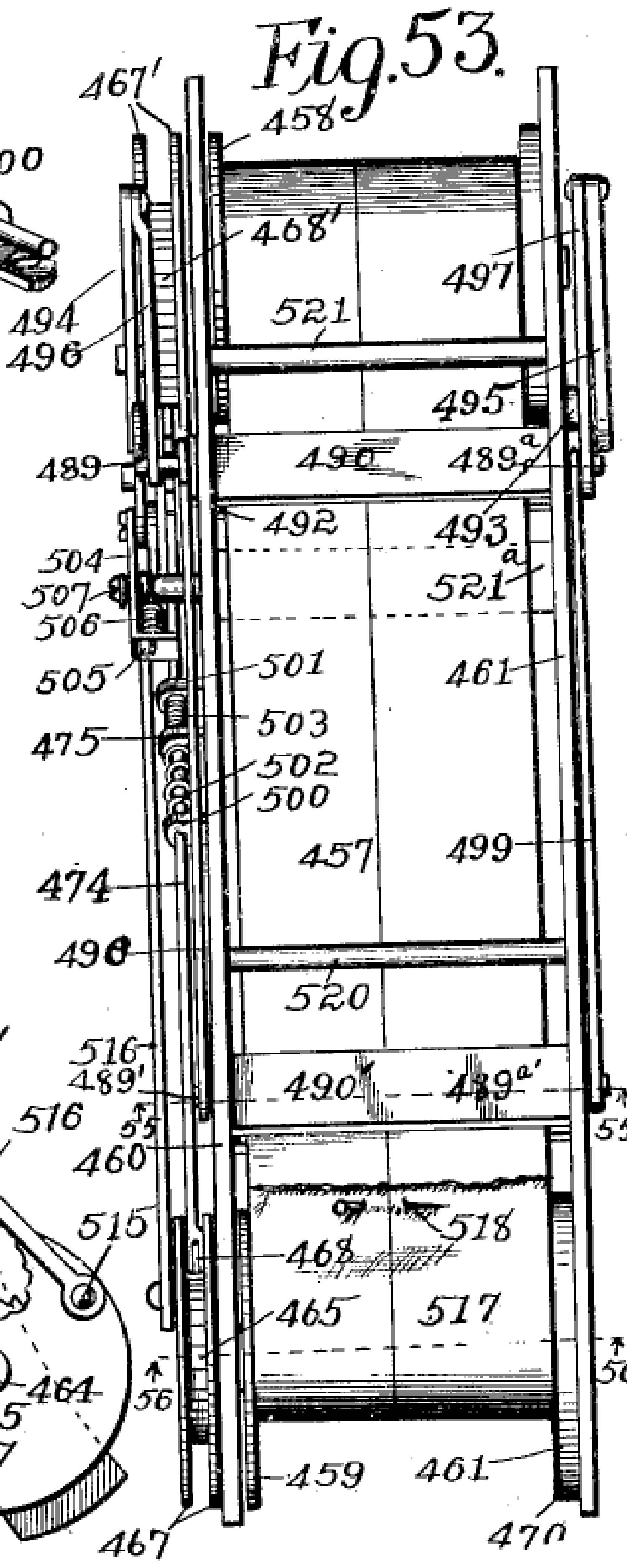
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Patented June 22, 1920.

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Witnesses
A. G. Hague
A. A. Thomas

Inventor
Martin Teetor
by Wallace R. Lane atty

M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED MAR. 3, 1911.

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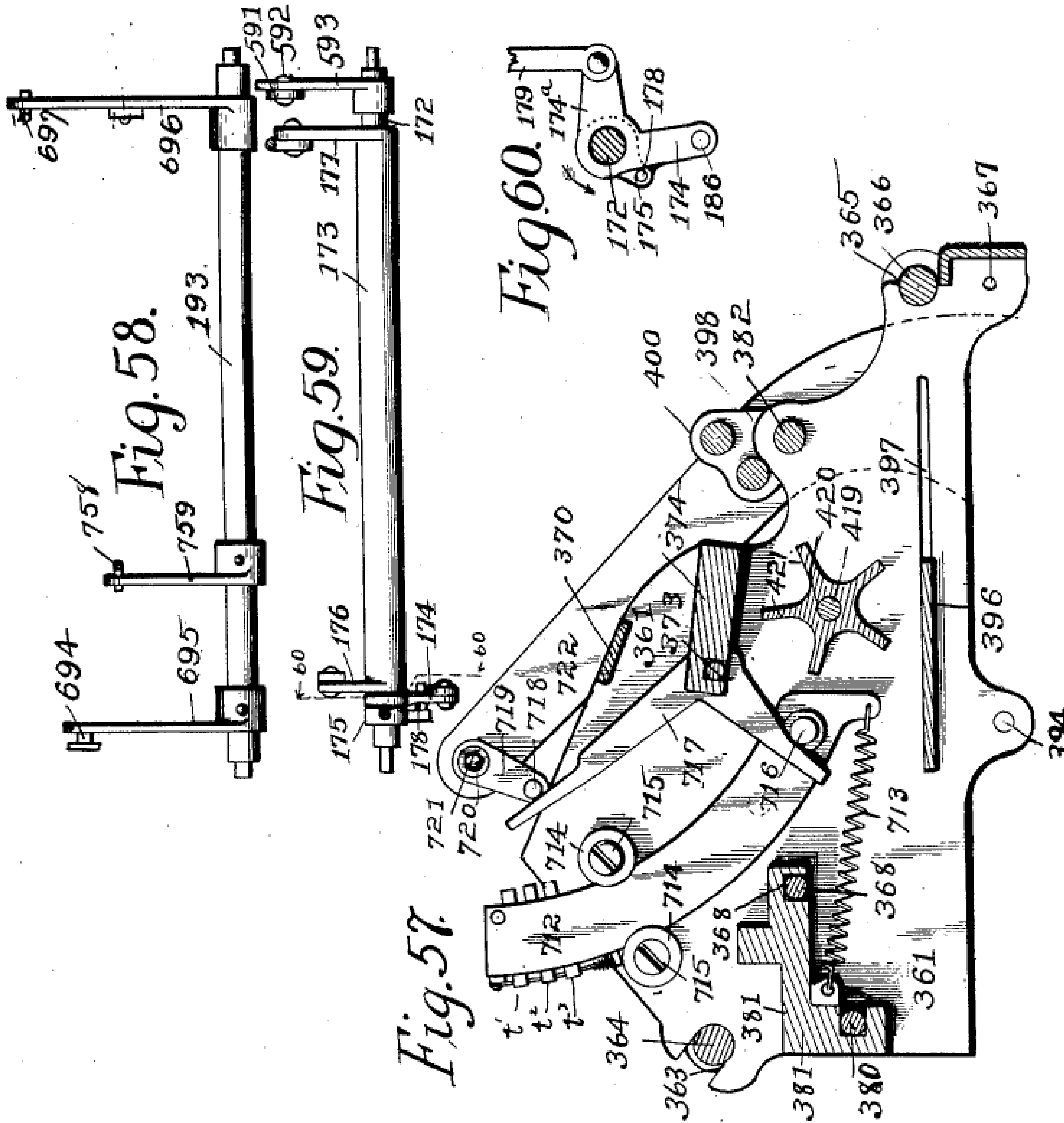


Fig. 61.

Witnesses

A. G. Hague.

A. Thomas

Inventor

Martin Teetor.

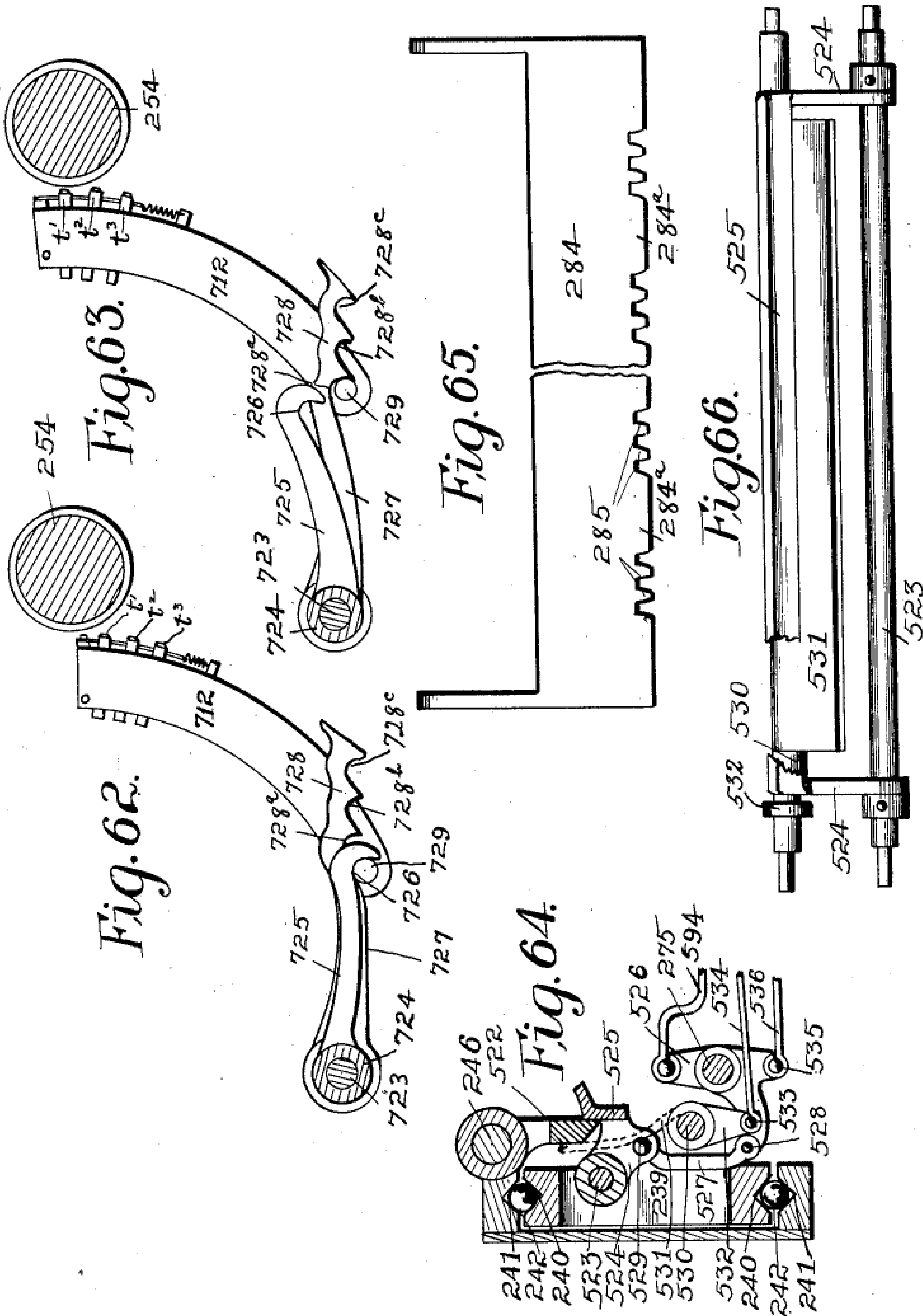
by Wallace R. Lane atty

M. TEETOR.
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Witnesses
A. G. Hague.
A. A. Thomas

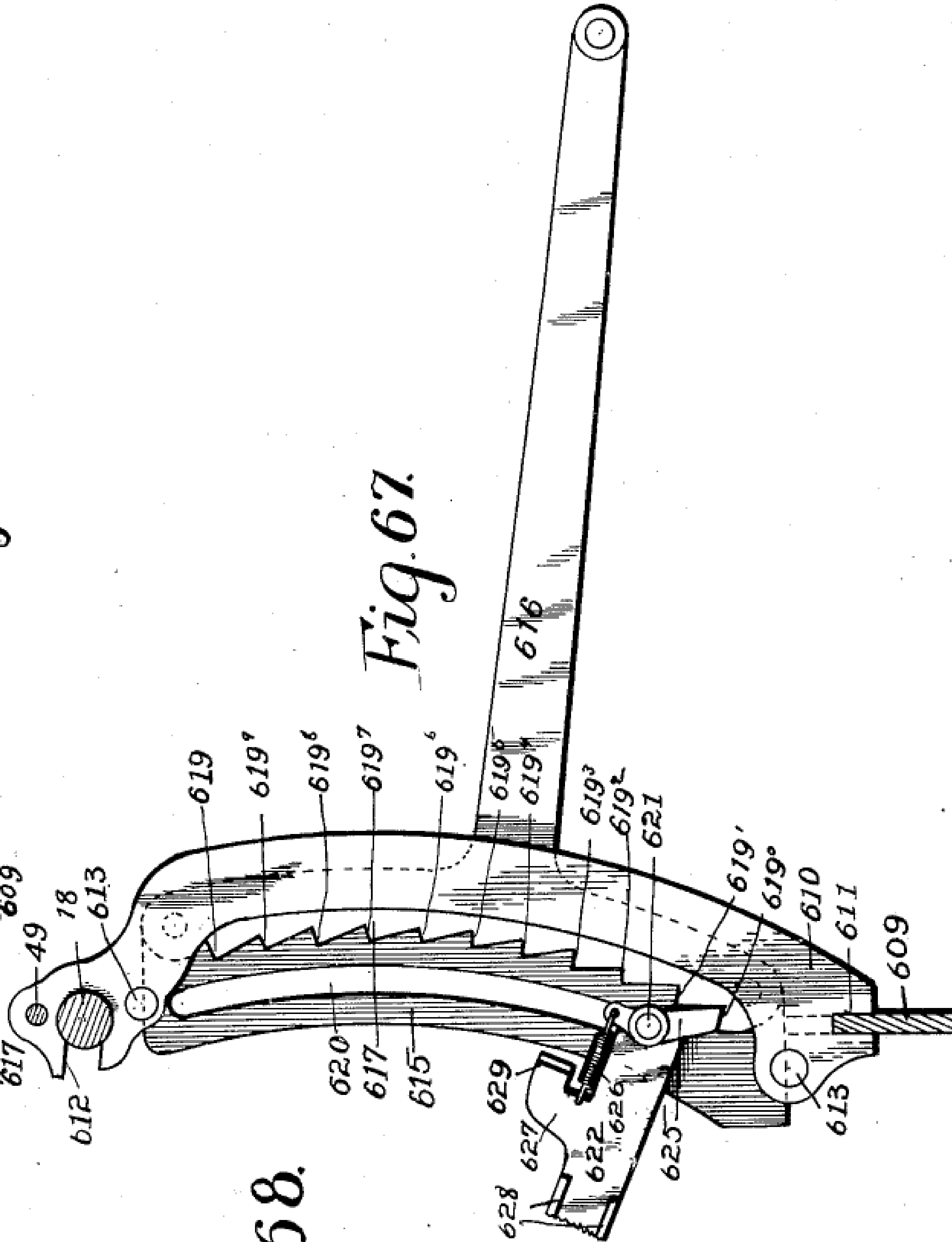
Inventor
Martin Teetor.
by Wallace R. Lane atty

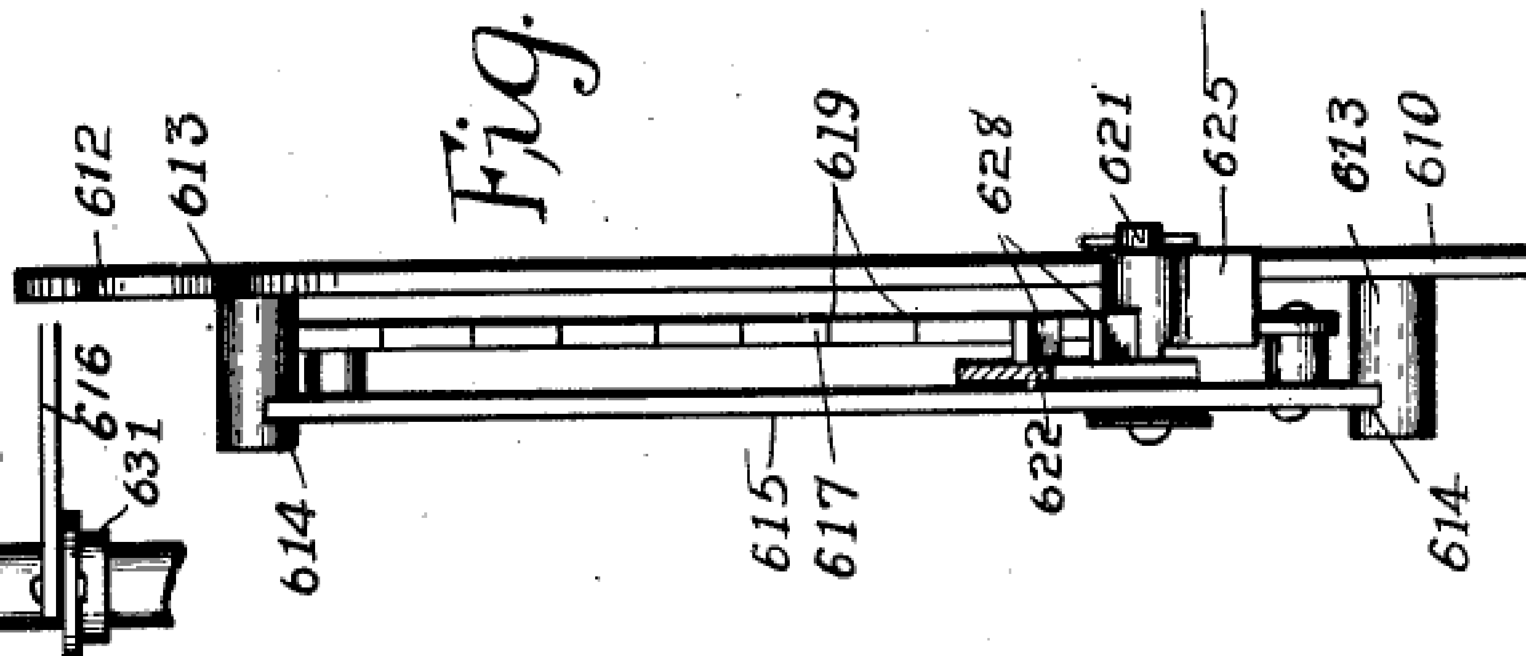
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M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED MAR. 3, 1911.

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Patented June 22, 1920.
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Witnesses
A. G. Hague
A. A. Thomas

Inventor
Martin Teetor,
by Wallace R. Lane, atty.

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M. TEETOR.

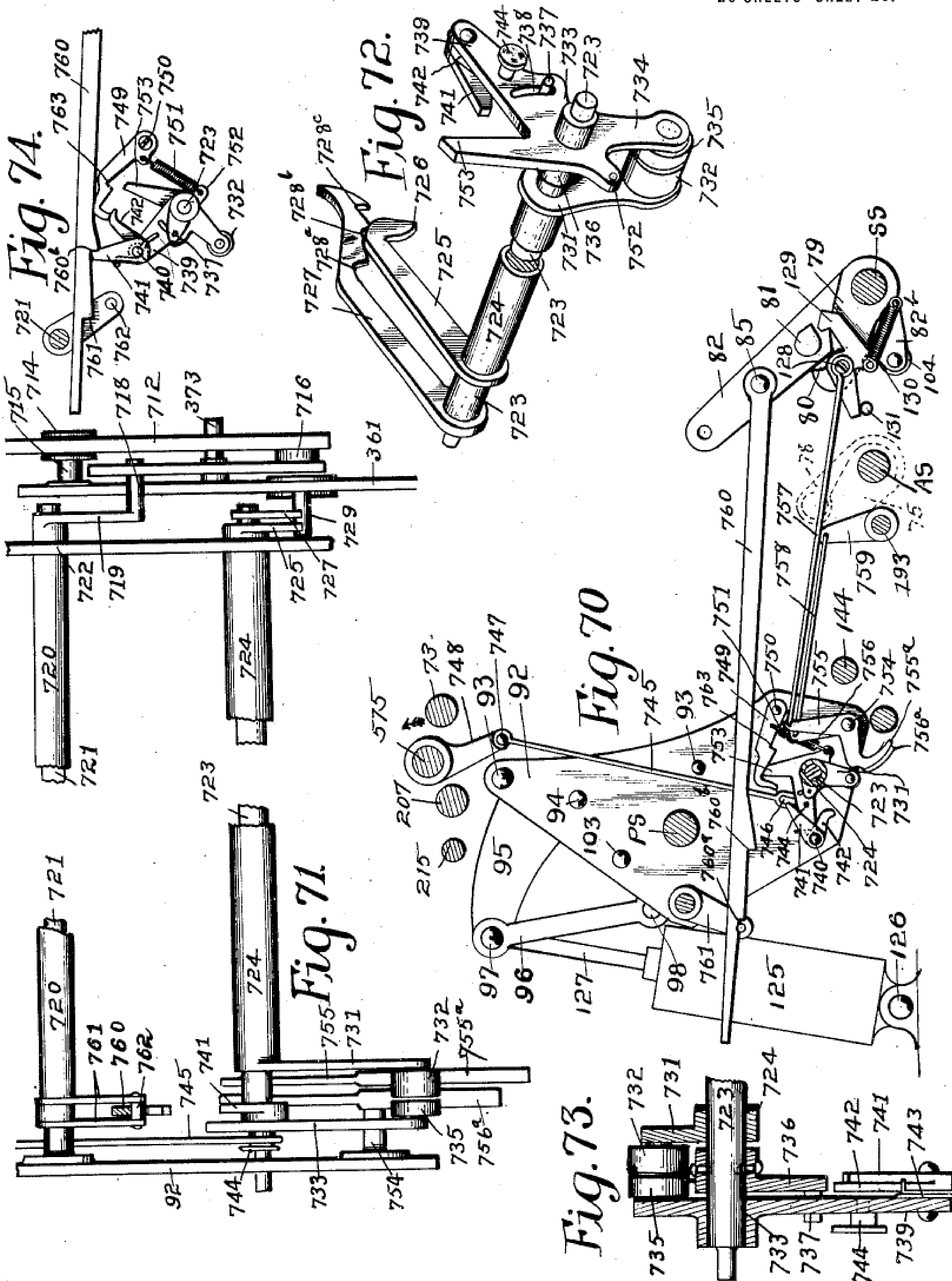
CALCULATING MACHINE.

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20 SHEETS—SHEET 20.



Witnesses
A. G. Hague
A. A. Thomas

Inventor
Martin Teetor
by Wallace R. Lane atty

UNITED STATES PATENT OFFICE.

MARTIN TEETOR, OF DES MOINES, IOWA, ASSIGNOR TO TEETOR COMPANY, OF DES MOINES, IOWA, A CORPORATION OF IOWA.

CALCULATING-MACHINE.

1,344,191. Specification of Letters Patent. Patented June 22, 1920.

Application filed March 3, 1911. Serial No. 612,127.

To all whom it may concern:

Be it known that I, MARTIN TEETOR, a citizen of the United States, residing at Des Moines, County of Polk, and State of Iowa, have invented a new and useful Improvement in Calculating-Machines, of which the following is a specification.

Broadly stated, the object of my invention is to provide a calculating machine capable of performing adding and subtracting operations, these operations being indicated by calculating mechanism and recorded by printing mechanism, both of which mechanisms are controlled by a single keyboard.

My novel form of calculating machine which forms the subject-matter of this invention comprises various combinations of elements which operate to effect certain predetermined results. The many features of novelty which characterize my invention are productive of operations which machines of this class heretofore constructed are incapable of carrying out. Among the more salient features of novelty which are included in the subject-matter of this invention, I may here briefly mention the following:

1. A novel and simplified form of operative connections between the calculating wheels and the keyboard for controlling the actuation of the numeral wheels in accordance with the set-up on the keyboard, the actuation of the numeral wheels being in a positive or in a negative direction as the case may be, to add or subtract.

2. A novel and simplified form of carry-over mechanism associated with the calculating wheels.

3. A printing mechanism embodying various novel combinations of elements for actuating and controlling the printing hammers, for preventing operation of the machine when the printing platen is not in printing position, for shifting the printing ribbon after each printing operation, for controlling the position of the platen with respect to the hammers, for printing explanatory characters in connection with certain items to indicate the nature of those items—all as hereinafter fully described.

4. Connections between the keyboard and the calculating wheels whereby the total which is recorded by the printing mechanism may either be retained in the calculating wheels or cleared therefrom, as desired.

5. Mechanism for storing an item for any length of time in the machine and for subsequently entering that item into the calculating wheels, without in the least interfering with the other operations of the machine.

6. Mechanism for dividing or splitting the calculating wheels and the corresponding printing hammers into two or more independently operative sections, so that different sections of the keyboard may be assigned to as many different accounts, whereby the machine operates as though it were provided with a plurality of independent keyboards.

My invention includes such further objects, advantages and capabilities as will later more fully appear.

My invention further resides in the combination, construction, and arrangement of parts illustrated in the accompanying drawings, and while I have shown therein preferred embodiments I desire the same to be understood as illustrative only and not as limiting my invention.

In the accompanying drawings illustrating my invention,

Figure 1 represents a plan view of a machine constructed in accordance with my invention.

Fig. 2 is a longitudinal sectional view taken approximately on line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 2, except that certain of the parts shown in Fig. 2 are omitted in order to expose certain other parts for the sake of clearness of illustration.

Fig. 4 is a longitudinal cross-sectional view taken approximately on line 4—4 of Fig. 1, certain parts of the printing mechanism being, for the sake of clearness, omitted.

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Fig. 5 is a longitudinal sectional view taken approximately on line 5—5 of Fig. 1.

Fig. 6 is a view similar to Fig. 5, except that certain parts shown in Fig. 5 are omitted and other parts added to show certain operative connections hereinafter fully explained.

Fig. 7 is a transverse cross-sectional view taken approximately on line 7—7 of Fig. 1, certain of the parts being omitted to promote clearness of illustration.

Fig. 8 is a front end view of the machine, a portion of the front plate being broken away to expose certain parts within the casing.

Fig. 9 is a detached detailed view of the mechanism for actuating the numeral wheels from the main power shaft, and also showing the carry-over mechanism associated with the numeral wheels.

Fig. 10 is an edge view of Fig. 9 looking from left to right, certain of the parts at the left of Fig. 9 being omitted for the sake of clearness.

Fig. 11 is a fragmentary view in longitudinal cross section, showing the frictional driving connection between the power shaft and the arms which carry the calculating sectors as well as the printing type.

Figs. 12, 13 and 14 are cross-sectional views of Fig. 11, to show certain details of construction.

Fig. 15 is a fragmentary detailed view showing the key-controlled connections for returning the item-storing mechanism to initial position.

Fig. 16 is a fragmentary detailed view of the cam-plate and its immediately associated parts for controlling the operative position of the numeral wheels by means of the subtracting lever, the dotted lines indicating the position which the parts assume when the numeral wheels are in their operative position.

Fig. 17 is a fragmentary view into the interior of the casing showing a portion of the mechanism for storing any desired item in the machine.

Fig. 18 is a face view of the cam which is operated by the crank shown in Fig. 17, for actuating the item-storing arm to operative position.

Fig. 19 is a detailed view of certain locking dogs associated with the cam shown in Fig. 18.

Fig. 20 is a rear end view of Fig. 16 looking from right to left, certain connections not shown in Fig. 16 being shown in Fig. 20.

Fig. 21 is a fragmentary rear end view of certain parts shown in Fig. 4.

Fig. 22 is a cross-sectional detailed view taken approximately on line 22—22 of Fig. 8, showing the locking plate for the levers H and S indicated in Fig. 1.

Fig. 23 is a fragmentary plan view of the mechanism for temporarily locking the adding and the subtracting levers in actuated position and for preventing return movement of these levers before completion of the forward movement.

Fig. 24 is a rear end view, partly broken away, showing the subtracting shaft and associated actuating mechanism.

Fig. 25 is a fragmentary detailed view in side elevation, showing one of the error keys and certain of the associated connections, and also showing one of the levers which operate the mechanism for splitting or dividing the calculating mechanism and the printing mechanism, as hereinafter described.

Fig. 26 is a detailed plan view approximately on line 26—26 of Fig. 8, showing how the error key is retained in any one of its adjusted positions.

Fig. 27 is a plan view of the head of an error key.

Fig. 28 is a detached side view showing certain connections controlled by the general repeat key and the total key.

Fig. 29 is a fragmentary detailed view showing how the operation of the numeral wheels is controlled when the total is taken, this controlling of the numeral wheels being effected by the total key.

Fig. 30 is a fragmentary detailed view in plan showing how the numeral wheels are mounted on a suitable rock shaft, and also showing the actuating arm which connects the rock shaft with the slotted cam-plate shown in Fig. 16.

Fig. 31 is a detached view in perspective, partly broken away, of the common restoring bar running transversely of the machine near the front end thereof, for restoring the depressed keys.

Fig. 32 is a side view of the left end portion of the mechanism shown in Fig. 31.

Fig. 33 is a fragmentary detailed view taken on a longitudinal cross-sectional line of the machine casing, showing the common restoring bar in operative position.

Fig. 34 is a rear end view of the printing mechanism.

Fig. 35 is a view in plan of the printing mechanism.

Fig. 36 is a sectional view taken approximately on the line 36—36 of Fig. 35.

Fig. 37 is an end view of the platen carriage and supporting frame taken approximately on line 37—37 of Fig. 35.

Fig. 38 is a detailed view in longitudinal cross-section of one of the hammer sections of the printing mechanism.

Fig. 39 is an edge view of Fig. 38 substantially on line 39—39, looking toward the left, certain of the parts shown in Fig. 38 being omitted and certain additional parts shown for the sake of clearness.

Fig. 40 is a fragmentary detailed view

of the upper portion of the printing hammer.

Fig. 41 is a fragmentary detailed view of a slide-bar shown in Fig. 38 for throwing the associated hammer out of operation.

Fig. 42 is a detailed view in perspective showing the parts actuated by the bar shown in Fig. 41 for throwing the hammer out of operation.

Fig. 43 is a view in perspective of a bar which forms a part of the mechanism for transmitting motion from one hammer to the other to permit the printing of zeros to the right of a significant figure.

Fig. 44 is a face view of a portion of the type bar for printing certain explanatory characters in connection with the ordinary numerical items.

Fig. 45 is a fragmentary detailed view of the mechanism for releasing the printing hammers for actuation.

Fig. 46 is a reverse view of certain parts shown in Fig. 45.

Fig. 47 is a plan view of the mechanism shown in Fig. 45.

Fig. 48 is a detached view of the connections whereby the platen carriage is shifted when the adding or subtracting lever is operated.

Fig. 49 is a cross-sectional view of the lower right-hand portion of the mechanism shown in Fig. 48.

Fig. 50 is a detached detailed view showing the connections whereby the operation of the carriage shifting mechanism shown in Fig. 48 is adjusted by means of a crank secured to the side of the casing.

Fig. 51 is a partly cross-sectional view of the crank-controlled arm shown in Figs. 48 and 50.

Fig. 52 is a detached side view of the ribbon shifting mechanism.

Fig. 53 is a face view of the mechanism shown in Fig. 52 looking toward the left of that figure.

Fig. 54 is a perspective view of a portion of the mechanism shown in Fig. 52.

Fig. 55 is a transverse cross-sectional view taken approximately on line 55—55 of Fig. 53, showing the slotted rod through which the printing ribbon passes.

Fig. 56 is a transverse cross-sectional view taken approximately on line 56—56 of Fig. 53, and showing one of the ribbon spools.

Fig. 57 is a sectional view taken approximately on line 57—57 of Fig. 39 and showing the mechanism for operating the printing segment which carries the explanatory characters shown in Fig. 44.

Fig. 58 is a detached view showing the shaft operated by the printing key, and the arms secured to said shaft for actuating other connected parts.

Fig. 59 is a detached view of the shaft operated by the total key and the sleeve mounted on said shaft to be operated by the adding and subtracting keys.

Fig. 60 is a view taken on line 60—60 of Fig. 59.

Fig. 61 is a face view of a portion of a sheet taken from the machine showing items printed during the various operations of the machine, as hereinafter explained.

Fig. 62 is a fragmentary detailed view showing the inoperative or normal position of the printing sector which carries the explanatory characters shown in Fig. 44.

Fig. 63 is a view similar to Fig. 62 showing the printing sector in the first operative position, which, in the particular instance illustrated, is the position in which a minus sign (—) is printed opposite an item which is to be subtracted.

Fig. 64 is a cross-sectional detailed view of the locking mechanism for the platen, this view also showing a portion of the connections for controlling this locking mechanism.

Fig. 65 is a detached face view of one of the rack-bars mounted on the platen frame and designed to engage the platen shifting carriage.

Fig. 66 is a plan view of the two locking plates shown in Fig. 64 for locking the platen frame against movement out of printing position.

Fig. 67 is a side view of a portion of the item-storing mechanism.

Fig. 68 is an end view of Fig. 67 looking from left to right.

Fig. 69 is a cross-sectional view taken approximately on the broken line 69—69 of Fig. 3, certain of the parts being for the sake of clearness omitted, to show the item-storing mechanism.

Fig. 70 is a detached side view of a portion of the mechanism for operating the printing sector which carries the explanatory characters shown in Fig. 44.

Fig. 71 is substantially a left end view of Fig. 70.

Figs. 72, 73 and 74 are detailed views of various portions of Figs. 70 and 71.

Before attempting a detailed description of the construction and operation of the various mechanisms and connections which go to make up my new machine, I will set out a general description of the different operations capable of being carried out by the machine of this invention. With a general idea of the capabilities of my new form of adding machine, it will perhaps be easier to follow the subsequent detailed description of the figures in the drawings. For this preliminary and general description it will be necessary to refer only to the plan view shown in Fig. 1.

General operation, (Fig. 1).

It will be observed that the keyboard por-

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tion of the casing in which most of the operative parts are inclosed, is divided into longitudinal sections indicated by S^1 to S^8. With each section is associated an order or row of numeral keys *k*. There being eight rows of keys shown in the particular embodiment illustrated, the number of keyboard sections also is eight. These sections are removable each independently of the others. From each section extends a partition downwardly into the casing and on this partition are mounted various parts connected with the associated row of keys When, therefore, any particular section is removed from the keyboard a portion of the interior mechanism of the machine is also removed together with the corresponding order of keys. In this way it is possible to readily remove certain of the interior mechanism for inspection or repair, without disturbing other parts or connections. When it is desired to enter a certain number in the machine in a positive or adding direction, the number is first set up on the keyboard by depressing the particular key in each of the orders required by the number, whereupon the adding lever A L is drawn forwardly as far as its movement is permitted. The lever is then released, or rather it may be released, for it becomes locked in its actuated position until the parts which have been set in operation by the forward movement of the lever have caused rotation of the numeral wheels in accordance with the set-up on the keyboard. The numeral wheels are in Fig. 1 indicated by n^1 to n^8 inclusive, there being a numeral wheel for each order or row of numeral keys. The connections between each order of keys and the associated numeral wheel are such that the mechanism for operating that numeral wheel is controlled by the particular key depressed in that row. Consequently the number set up on the keyboard will appear on the numeral wheels through the sight openings 10. When the numeral wheels have thus been properly actuated, the adding lever is automatically returned to its initial or normal position. The forward movement of the adding lever A L causes not only the operation of the numeral wheels, but also the operation of the printing mechanism to print the number previously set up on the keyboard. The printing mechanism is attached to the rear of the machine and is in Fig. 1 indicated as a whole by the reference character P M. The printing mechanism is normally always in operative position and the mere operation of the adding lever is sufficient to cause the set-up on the keyboard to be entered in the numeral wheels as well as printed on a sheet of paper on the printing platen. If a second item is to be entered in the machine in a positive direction, the manipulation of the keyboard and the adding lever A L is repeated as just described, whereupon this second item will be added to the previous item in the numeral wheels and will be printed under the previous item on the paper in the printing mechanism. In this way any number of positive items may be entered in the machine. The numeral wheels show the sum of these items, while the printing mechanism prints these items one below the other in proper alinement.

When it is desired to subtract a number, the subtracting lever S L is operated instead of the adding lever, after the number to be subtracted has been set up on the keyboard. The effect of operating the subtracting lever S L is to cause operation of the numeral wheels in a negative or subtracting direction. At the same time the platen frame of the printing mechanism is shifted to bring the subtracting column into printing position. In other words, whereas the numbers to be added are printed in one column which may be called the adding column, the numbers to be subtracted are ordinarily printed in an adjacent column, which may be referred to as a subtracting column. By adjusting the crank C L shown at the left of the casing in Fig. 1, the negative items may be printed in the same column with positive items. In order to definitely identify negative items, no matter whether they are printed in a column by themselves or printed in the same column with the positive items, I have provided special means for automatically printing a suitable character or mark in connection with each negative entry to indicate that the particular entry is of a negative character and is to be subtracted. This identifying character is printed automatically when a negative entry is made, no other manipulation of the machine on the part of the attendant being necessary than the operation of the subtracting lever S L after the number has been set up on the keyboard. Since the numeral wheels are actuated in a positive direction when the adding lever A L is operated, and in a negative or reverse direction when the subtracting lever is operated, it is obvious that the indication of the numeral wheels at any time represents the arithmetical sum of the numbers entered into the machine.

To print the total (or "take the total," as it is usually called), the operator simply depresses the total key T K and then pulls the subtracting lever forward, no other manipulations than these being necessary on the part of the operator. The depression of the total key so controls the movement of the type bars of the printing mechanism that the number thus placed in printing position corresponds with the number which represents the total in the numeral wheels. When the total is in this way taken by the operation of the subtracting lever S L, the

numeral wheels are returned to zero position and the total is said to be cleared out of the machine. To retain the total in the machine, the adding lever A L is used instead of the subtracting lever, whereupon the numeral wheels are first returned to zero position and then back to the position in which they were just before the total was taken. This back and forth actuation of the numeral wheels to retain the total when the sum is printed, is automatically accomplished by the mere pulling forward of the adding lever, after the total key T K has been depressed.

Instead of using the subtracting lever S L to clear the machine when the total is taken, the operator may depress the subtracting key S K and use the adding lever A L to accomplish precisely the same result. The subtracting key S K is so connected with the adding key A K, that when one of the keys is in depressed position the other is in raised position. When, therefore, the subtracting key S K is depressed the adding key A K is raised. The normal position of these two interconnected keys may be said to be the one in which the subtracting key is raised and the adding key is depressed, because it is in this position of the keys that the adding lever performs its normal function of causing the numeral wheels to operate in a positive or adding direction. This normal or positive function of the adding lever is converted into a negative or subtracting function by the depression of the subtracting key S K. It is, of course, obvious that the adding lever may by this means be used for subtracting purposes at any time during the operation of the machine and not merely at the time of adding the total. By depressing the adding key A K the associated parts are restored to their normal position and the adding lever performs only a positive or adding operation.

The depression of the total key T K in taking the total, automatically locks the printing platen in printing position and also locks all of the numeral keys on the keyboard against depression. Furthermore, there is a connection between the printing mechanism and the operating levers A L and S L, whereby the machine is locked against operation when the platen is not in printing position. It will be seen that these provisions positively prevent any tampering with the total by the operator. No fictitious total can be set up on the keyboard, nor can the machine be cleared unless the amount in the numeral wheels is permanently recorded by the printing mechanism.

Also no item can be entered in the machine without causing that item to be printed. However, to meet the exigencies of a case in which it might for some reason or other be desired to operate the calculating mechanism of the machine without the printing mechanism, I have provided a key K which, when depressed, throws the locking mechanism for the platen out of operation and allows the actuation of the numeral wheels independently of the position of the planten—whether the latter be in printing position or tilted back out of this position, or even removed entirely from the machine. This special key K furthermore throws the printing hammers into inoperative position by breaking the connection between the hammers and the power shaft, so that the mere depression of the key K virtually removes the printing mechanism from the field of operation and permits the machine to be used like a register having only indicating wheels. Such use of the machine may in some instances be found desirable. Ordinarily, however, the automatic locking connections between the printing mechanism and the operating levers A L and S L will remain in operative condition so as to render it impossible for the operator to use the machine without making a permanent record of the items entered and the totals taken. For this reason, the special key K is made removable and it will ordinarily be left out of the machine in care of the proper officer.

In tabulating items it becomes frequently necessary to associate with certain items some form of explanatory memoranda for the sake of convenience or identification. For instance, it may sometimes be necessary to put down the number of a car, as in a bill of lading. Now this number, although entered by the printing mechanism on the record sheet, should not be entered in the calculating wheels because it is not an item which is either to be subtracted or added. In order to cause the printing of such an explanatory item without affecting the calculating wheels, I have provided a certain mechanism which is controlled by the printing key P K. The actuation of this key prevents the numeral wheels from being thrown into operation when the adding or subtracting lever is operated to print the explanatory number. I have also provided means for indicating on the record sheet that a certain number has been entered merely as an explanatory or identifying number and that it is to be eliminated in the process of addition and subtraction. When the printing key P K is depressed the special printing device hereinbefore referred to is automatically set to a position in which it will print a mark adjacent to the explanatory number to indicate to the inspector of the record sheet that the number thus marked is to be neither added or subtracted. In the particular embodiment illustrated in the drawings the printing key P K performs

another function besides the one specified. I have made the printing key removable from the keyboard and when it is removed the machine is automatically locked against operation. When, therefore, the operator wants to lock his machine so as to prevent unauthorized or mischievous tampering therewith by others—as when he leaves the machine during the noon hour or at the close of the day's work—all he has to do is to pull out the printing key P K, which he might either be permitted to retain in his possession or else deliver unto the custody of the proper person.

It some times happens that the same item is to be entered several times in succession in the machine. To obviate the necessity of successively setting up the same number, I have provided a general repeating key R K, which, when depressed, renders the key-restoring means inoperative, whereby the set-up is retained even after the operating lever and the connected parts have returned to normal position. The sum set up is retained on the keyboard as long as the repeating key R K remains depressed.

With each order or row of numeral keys there is associated a rotatably adjustable error key E K bearing thereon suitable characters to indicate the adjusted position of the key. For the sake of illustration, I have in the drawings shown these characters as consisting of the letters "E," "R" and "L." Each error key has independent control of the associated row of numeral keys. When an error key is in the position where the letter "E" is toward the rear of the machine, as shown in Fig. 1, the depressed numeral key of the associated row may be restored to original position—as, for instance, when the wrong key has been depressed and it is desired to correct the error. In this way, if the wrong key has been struck, that key may be restored without affecting the other depressed keys. When an error key is turned so that the letter "R" points rearwardly, the depressed key of the associated row of numeral keys will not be affected by the restoring mechanism, but will remain depressed as long as the error key remains in that adjusted position. It will thus be seen that in the "R" position (as this second position may be called), an error key operates as a repeating key individual to the associated row of numeral keys. When an error key is turned so that the letter "L" points directly to the rear of the machine, the error key is locked in depressed position, and thereby prevents operation of any key in the row controlled by that particular error key.

It will be observed in Fig. 1 that at the front of the machine there is associated with each keyboard section a pair of keys or levers H and S. When the lever H of a particular section is pushed down the corresponding hammer of the printing mechanism is automatically thrown out of operation, and no printing will be done by that hammer. When the lever S of a section is pushed down the printing hammers are split or divided at a certain point and operate in two independent sections. For instance, if the lever S of the sixth or hundred-thousand section s^6 be pushed down, the hammers corresponding to the keyboard sections s^7 and s^8 will, as it were, be isolated from the other hammers and perform their printing operations independently of those other hammers. Ordinarily, when an entry has the last significant figure in a higher order, (as for instance the number 34,000) the hammers automatically print the zeros to the right of the figure "4". However, when the hammers are split or divided at a certain point, the printing of zeros does not take place across the point of division. For example, if the hammers corresponding to the keyboard sections s^7 and s^8 are split from the other hammers, and an entry is made having the lowest significant figure in the seventh or millions row, no zeros will be printed to the right of that figure, although the lower order hammers are free to operate in accordance with the set-up on the lower-order keyboard sections. The operation of any particular lever S not only splits or divides the printing hammers, but it simultaneously divides the carry-over mechanism of the numeral wheels at a corresponding point. It will thus be seen that the purpose of the levers S, which may properly be called split levers, is to split the machine both in its printing mechanism and calculating mechanism, into two or more independently operative sections. The advantages of this will be more fully discussed hereinafter. The hammer-killing levers H and the splitting levers S are normally locked against operation, and it is necessary that the finger piece H S be depressed to release the levers and permit operation thereof.

It may sometimes be found desirable or necessary to clear the machine and yet it is desired to retain the number cleared for subsequent calculations. To this end I have provided what I call an item-storing mechanism which operates quite independently of the calculating wheels to store any entry which may be indicated by the calculating wheels. This item-storing mechanism is set in operation by means of the crank or lever I L projecting from one side of the casing, as shown in Fig. 1. To store an item or entry, the operator pulls the crank toward him as far as it will go, whereupon he may release it. Then having depressed the total button he operates either the adding lever A L or the subtracting lever S L, according

as to whether the entry in the numeral wheels is to be retained or cleared. This causes the item-storing mechanism to operate in accordance with the entry in the numeral wheels and virtually stores that item. The machine may then be operated in the usual way to add or subtract any given items, without being in the least interfered with by the item-storing mechanism. When it is subsequently desired to enter the stored item into the numeral wheels, the operator depresses the key or lever I K and turns the crank I L one complete revolution in a direction reverse to that in which it was previously operated. If the stored item is to be entered in a positive direction, the adding lever is then operated. If the stored item is to be entered negatively, the subtracting lever is operated. By depressing the key I R the operator restores the item-storing mechanism to normal position.

I have under this heading endeavored to briefly set out the various operations which may be performed by my new form of adding machine, so as to give a general idea of the main characteristics that distinguish my invention. Many other features of novelty in addition to those which have been mentioned in this preliminary description, will become apparent from the detailed description of the structural embodiment of my invention, as illustrated in the drawings. To render the detailed description of the drawings as clear as possible, so that the same may be readily followed without confusion, I have thought it best to divide the description into sections or chapters, each of which takes up in detail the mechanism for accomplishing a certain operation or set of operations.

Key-controlled mechanism for operation of numeral wheels, (Figs. 1, 2, 4, 5, 8 to 14 inclusive, 16, 23, 24 and 25.)

The casing of the machine comprises a pair of side plates 1 and 2 and bottom piece 3, a front plate 4, and a top or cover indicated as a whole in Fig. 1 by 5. The rear section 6 of the cover is pivoted to the front section 7 at 8. The cover sections are shaped to fit over the side pieces and are firmly held in place by any suitable means. On the top section 7 is provided a plate 9 having sight-openings 10 opposite the calculating wheels so that the indications of the latter may be observed through the openings. The front portion of the cover forms part of the keyboard proper and is divided into a plurality of longitudinal sections, there being as many sections as there are orders or rows of numeral keys. As already explained, in connection with Fig. 1, in the particular embodiment illustrated in the drawings there are eight rows of numeral keys k and consequently there are eight keyboard sections indicated by s^1 to s^8 inclusive. These section pieces are each preferably ribbed or beaded at one edge, as indicated at 11 in Fig. 8, the sections overlapping at that point so as to be firmly held together and at the same time present a neat appearance. However, this overlapping feature may be omitted, especially if it is desired that each section shall be removable without disturbing any of the other sections. As shown in Fig. 8 the sections are removable in the order from right to left. The two end sections 12 and 13 need not be removable and will ordinarily be integral with the cover. Through the end section 12 project the special keys P K, K, A K, S K, R K, and T K, which have briefly been referred to in the preceding chapter and will again be referred to hereinafter, in connection with other mechanisms. Through the other end section 13 extend the keys I K and I R, which have to do with the item-storing mechanism to be subsequently explained in detail. Within the front portion of the casing underneath the keyboard sections is a series of supporting plates or partitions 14, there being one plate for each order of keys, as shown in Figs. 2, 3 and 8. These plates are each provided with a lower hook portion 15 adapted to engage the fixed transverse shaft 16 and with an upper hook portion 17 for engaging the fixed transverse shaft 18, as shown in Fig. 3. The shafts 16 and 18 are rigidly mounted in the sides of the casing and constitute the supports for the plates 14. It will be seen that the hooked engagement between the plates 14 and the shafts 16 and 18 permits the plates to be readily removed from the shafts by simply sliding the plates a little forwardly. A bar 19 is secured to each of the plates 14 for pivotally supporting the bell-cranks 20. There are nine of these bell-cranks supported by each plate, and to the upper arm of each bell-crank is pivoted a numeral key k, the point of pivot being indicated at 21, as shown in Figs. 2 and 3. Each row of numeral keys comprises nine keys representative of the numerals 1 to 9 inclusive, the front key representing the numeral 1, the next key the numeral 2, and so on in succession. With each row of keys is associated a pair of leaf-springs 22 which are wound in and out between the key stems, as shown in Figs. 2, 3 and 69. These springs have sufficient frictional engagement with the keys to retain the latter in depressed or raised position and yet offer but little resistance to the movement of the keys. Each plate or partition 14 carries a stud 23 to which is pivoted the double bell-crank 24. To the upper arm of this double bell-crank is pivoted the combined locking and restoring plate 25, the point of connection being shown at 26. The other end of the plate 25 is pivotally connected to the partition 14 by

means of the link 26^a. A spacing bar 27 is carried by the partition between the bell-cranks 20 and the restoring plate 25, as shown in Fig. 2. The lower arm of the double bell-crank 24 is provided with an inwardly-extending stud 28 adapted to engage the arm 29 which is rotatably mounted upon the stud 23, as shown in Figs. 2 and 25. With each row of keys is associated an error key E K which projects through the cover of the casing at the front of the machine. As indicated in Figs. 2, 3 and 8, each error key is provided with a rotatable sleeve 30 held in place by a pair of collars 31 fixed to the key stem. A link 32 connects the sleeve 30 with the forwardly-extending arm of the double bell-crank 24. As seen from Figs. 2 and 25, the restoring plate 25 is provided with openings 33 substantially rectangular in form, there being an opening for each key. The lower arms of the bell-cranks 20 carry lugs 34 which extend toward the associated plate 25 and are adapted to engage in the slots or openings 33. By reference to Fig. 2, it will be seen that when the keys are in their normal position the lugs 34 rest at the rear ends of the slots 33. When, therefore, any key in a row is depressed the bell-crank connected to the depressed key will slide the plate 25 rearwardly. To the lower end of each bell-crank 20 is pivotally connected a link extending toward the rear of the machine, these links being indicated by the reference characters a^1 to a^9, inclusive. The numerical suffixes of these reference characters are intended to identify the key to which any particular link is connected. Thus the link a^1 is connected to the "1" key; the link a^6 is connected to the "6" key, etc. These key links are at their rear ends provided with lateral setting pins b^1 to b^9, inclusive, respectively. A plan view illustrating the lateral relation of the pins b^1—b^9 is represented in Fig. 69, which shows the pin b^9 projecting laterally from the link a^9. The pins b^1—b^9 normally rest in the open ends of the radial slots 35 provided in the sector 36 which is secured to the partition 14 by means of studs or rivets 37, as shown in Figs. 2 and 9, the sector being spaced from the partition, as shown in Fig. 69. With each sector 36 is associated a retaining plate 38 for preventing the pins b^1—b^9 from slipping out of the slots 35. The retaining plate 38 is mounted on the partition 14 by means of the studs 39 which engage the hook portions at the upper and lower ends of the retaining plate, as best shown in Fig. 9. The retaining plate is situated in the space between the partition and the slotted sector 36, as shown in Fig. 69. The rear edge of the retaining plate is curved in the arc of a circle concentric with the curvature of the sector 36 and so arranged with respect to the slots that it prevents the pins from passing out of the slots. However, the retaining plate 38 does not interfere with the rearward movement of the pins. By reference to Figs. 2 and 25 it will be observed that the arm 29 has pivotally connected thereto the link a^0. The rear end of this link terminates in a lateral pin b^0 which normally rests in the base of the slot 35^0 in the sector 36. The link a^0 will hereinafter be referred to as the zero link and the pin b^0 will henceforth be called the zero pin, for the sake of brevity and clearness. From the above description it will be apparent that when any numeral key of a row is depressed the corresponding setting pin is moved rearwardly toward the base of the slot 35 in which it works. At the same time the lower arm of the double bell-crank 24 is rocked forwardly and the lateral lug 28 on this arm draws the arm 29 forwardly, thereby moving the zero pin forwardly to the open end of the slot 35^0. The purpose of the withdrawal of the zero pin when a numeral key is actuated will be presently explained.

Each partition 14 is at its lower front end provided with a lateral projection 40, as shown in Figs. 8 and 25. The lower portion of the stem of each error key E K works in the bearing lug 41 carried by the partition 14. Above the bearing lug 41 the error key is provided with a fixed block 42. As shown in Fig. 26, the block 42 has three flat sides adapted to coöperate with the leaf-spring 43 to hold the error key in any one of three positions to which it may be rotatably adjusted. The leaf-spring 43 is secured to the partition and the lower portion thereof is offset from the partition, as shown in Fig. 8, so as to yield toward the partition when the key is rotated. The lower end of each error key is provided with a lateral projection 44 which is adapted to engage the under surface of the lug 40 on the partition 14 to lock the key in depressed or normal position. On the shaft 45 which runs transversely of the machine and is secured at its opposite ends to the sides of the machine casing, is mounted the rotatable sleeve 46. As best shown in Fig. 31, the sleeve 46 carries at its ends a pair of forwardly extending arms 47 to which is secured the angular restoring-bar 48. As clearly seen from Fig. 8, the restoring-bar 48 is common to all of the keyboard sections. The arrangement of the locking bar 48, with respect to the error key E K, is such that when the toe or lug 44 of an error key is turned rearwardly the forward rocking of the common locking bar 48 pulls the raised error key downwardly and holds it in such depressed position, thereby causing forward movement of the restoring plate 25 to restore the depressed numeral key of that row to normal position. As long as

the restoring-bar 48 remains in engagement with the toe 44 of an error key, the associated row of keys is locked against operation, as will be clearly understood. The bar 48 therefore not only performs a restoring function, but also a locking function. Furthermore, it will be apparent that the connection between the bar 48 and each row of numeral keys is controlled by the associated error key E K. Thus when the error key is in the position shown in Fig. 2, the toe 44 is out of the path of movement of the restoring-bar 48. This is also the case if the toe 44 is in a position at right angles to that shown in Fig. 2. These various positions of the error key are best shown in Figs. 26 and 27. In order that the operator may be informed of the position of the toe 44 the head of the error key is provided with suitable indicating characters. For the sake of illustration I have selected the letters "E," "R" and "L." When the error key is turned so that the letter "E" points directly to the rear, the toe 44 also points directly to the rear, as indicated by the dotted line position 44^e in Fig. 26. In this position of the error key the forward rocking of the restoring-bar 48 engages the toe 44 and pulls the error key down to restore the associated row of keys to normal position, as already explained. It should in this connection be remembered that when any key of a row is depressed the associated error key is raised. This "E" position of the error key may therefore properly be called the error position because it permits the restoring of a depressed key, so that if that key happened to be the wrong one the error may be corrected. When the error key is turned to a position where the letter "R" points to the rear, the toe 44 assumes a position parallel with the restoring-bar 48, as indicated in the dotted line position 44^r in Fig. 26. It will be apparent that when the key is in this position the downward movement of the restoring-bar 48 is not accompanied by any movement of the error key and that consequently the set-up on the associated row of numeral keys remains. This retaining of a set-up is of great convenience when an entry is to be repeated, or when certain digits remain the same for several successive entries. In this second or "R" position, the error key really performs the function of an individual repeat key, so that the set-up in any row of numeral keys may be retained for any length of time by merely adjusting the associated error key to the "R" or "repeat" position. When the operator turns the error key to a position in which the letter "L" points to the rear, the toe 44 extend toward the front underneath the transverse lug 40 of the associated partition 14. It is obvious that when the error key is in this position it is locked against upward movement so that it is impossible to operate any numeral key of the corresponding row. Hence this third position of the error key is the "L" or "locked" position, which is shown in Fig. 2.

From what has been said above with regard to the partitions 14 and the different parts connected thereto, it will be seen that when a keyboard section is removed by first sliding it off the supporting shafts 16 and 18, and then raising it, the connected partition 14 and the parts carried thereby will be removed with the section. The fixed partitions 14 are normally locked in position within the casing by the transverse rod 49 which runs transversely across the entire machine and passes through openings in the rear upper ends of the partitions, as shown in Figs. 3 and 9. By simply withdrawing this rod the partitions are in condition to be removed from the casing. Furthermore this rod serves to hold the partitions in rigid alinement with each other. I regard this feature of the sectional keyboard and the removal of the mechanism directly connected with each row of numeral keys as one of importance. The advantages of this sectional keyboard construction are obvious. When it is desired to inspect or repair certain of the interior mechanism, access to the desired part may be had by removing the proper section or sections. This is readily done without the use of special tools and without the necessity of dismantling the entire machine or disturbing other portions of the machine where repair or inspection is not needed.

The main power shaft P S runs transversely of the machine and is rotatably mounted in suitable bearings carried by the sides of the casing. It is on this shaft that the members for actuating the numeral wheels are mounted. The shaft is provided with longitudinal key-ways 50, as shown in Figs. 11, 12 and 13. The driving connections between the power shaft and the actuating members mounted thereon are best shown in Figs. 11 to 14 inclusive, to which reference will now be had. Fig. 11 shows one end of the power shaft mounted in the bearing 51 on the side piece 2 of the casing. The sleeve 52 which is keyed to the power shaft P S adjacent to the casing 2 terminates at its inner end in a disk 53 provided with a peripheral friction flange 54. The coil spring 55 which surrounds the sleeve 52 bears at one end against the disk 53 and at the other end against the recessed collar 56. To permit adjustment of the tension of the spring the collar 56 is movable longitudinally on the sleeve by being in screw-threaded engagement with the split ring 57. A series of sleeve members 58 are keyed upon the shaft at regular intervals. These sleeve members terminate each at one end in a disk 59 provided with a peripheral fric-

tion flange 60 and at the other end in a disk 61 provided with a peripheral friction flange 62. The key connection between the power shaft and the sleeve members 58 is effected by the disks 63 which are keyed directly to the power shaft and provided with lugs 64 which enter slots in the disks 61. Mounted loosely on the power shaft between each opposing pair of peripheral friction flanges are the controlling arm 65 and the lever 66, these two members being separated by a washer 67 keyed to the shaft P S. This washer is provided with a peripheral friction flange 68. There are as many pairs of controlling arms 65 and levers 66 as there are rows of numeral keys or orders of numeral wheels. It will be clear from Fig. 11 that each controlling arm 65 and associated lever 66 has a frictional driving connection with the power shaft through the friction flanges which are firmly though yieldingly held against opposite sides thereof. The pressure exerted by the spring 55 is transmitted from the disk 53 at one end to the fixed disk 69 at the other end and serves to establish a substantially uniform frictional connection between the power shaft and the arms or levers 65 and 66. It will be apparent that because of this frictional connection between the power shaft and the members 65 and 66 the rotation of the latter may at any time be interrupted by interposing a positive stop, without interrupting the rotation of the power shaft. The advantage and necessity of this feature will be presently made clear. Since each row of numeral keys has associated with it a controlling arm 65 and an actuating lever 66, it will be sufficient to describe the relation between any one row of numeral keys and the corresponding controlling arm 65 and actuating lever 66. By reference to Fig. 9 it will be observed that the controlling arm 65 rests normally at its free end against the stud 37. Also the arm is locked against movement by the zero pin b^0 which, as previously stated, normally rests at the bottom of the zero slot 35^0. The actuating lever 66 terminates at its forward end in the toothed sector 70 and at its other end in the curved printing arm 70′ which carries printing type. The actuating sector 70 is adapted to engage the pinion 71 which is rigidly connected to the numeral wheel *n*. The numeral wheels with their connected pinions are rotatably mounted upon the shaft 72 which is supported from the rock shaft 73 by the arms 74, as best shown in Figs. 9, 10 and 30. The numeral wheels and the pinions are prevented from sliding longitudinally on the shaft 72. If desired, each numeral wheel with its connected gear may be mounted upon a separate stub shaft, but as a matter of preference I have shown all of the numeral wheels mounted upon a single shaft whereby a positive alinement of the numeral wheels is secured. It will of course be understood that there is a numeral wheel for each row of numeral keys.

I will now describe the connections whereby the power shaft P S is actuated by the adding and subtracting levers. Near the bottom of the machine extends transversely the adding shaft A S which is rotatably mounted in bearings carried by the sides of the casing. At its right end the adding shaft A S projects beyond the casing to receive the adding lever A L, as shown in Fig. 1. The subtracting shaft S S extends transversely across the casing in front of the adding shaft A S and is rotatably journaled in bearings mounted on the sides of the casing. At its right end the subtracting shaft projects beyond the casing to receive the subtracting lever S L, as shown in Fig. 1. On the adding shaft A S is rigidly mounted the short arm 75 having a recessed portion 76 to engage the pin 77 carried on the arm 78 which is loosely mounted on the adding shaft adjacent to the fixed arm 75. This is clearly shown in Fig. 5. The subtracting shaft S S has rigidly mounted thereon the arm 79 having a hook portion 80 adapted to engage the pin 81 on the bifurcated arm 82 which is rotatably mounted on the subtracting shaft. The arms 78 and 82 are connected together by the link 83 which is pivotally connected to the studs 77 and 81. An end view of the construction just described is presented in Fig. 24. It will be seen from this figure that the bifurcated arm 82 is rotatably mounted on the subtracting shaft S S by means of the sleeve portion 84. On the pin 85 carried by the bifurcations of the arm 82 is loosely mounted the plate 86 which is provided with a pair of perforated ears 87 (see Fig. 5), for receiving one end of the operating springs 88. The other end of the springs 88 is connected to the plate 89 similar to the plate 86. The plate 89 is loosely supported on a pivot stud 90 on the bell crank 91. The form of this bell crank is perhaps best shown in Fig. 6, the rear portion thereof being shown in Fig. 5. The bell crank 91 is rigidly mounted upon the power shaft P S near one side of the casing, as shown in Fig. 7. Viewing the machine from the front, the connections just described between the power shaft and the adding and subtracting levers are located near the right side of the machine. The fixed plate 92 is secured to the right side 2 of the casing by studs 93 which hold the plate 92 at some distance from the side piece, as best shown in Fig. 7. Between the side of the casing and the fixed plate 92 is rotatably journaled a stub shaft 94 on which is fixedly mounted one end of the arm 95. A link 96 is at one end pivoted to the stud 97 on the arm 95 and at the other end pivoted

to the stud 98 on the bell crank 91, whereby the arm 95 and the bell crank 91 are connected together. The bar 99 which is at its rear end pivoted to the stud 90 on the bell crank 91 is provided with a slot 100 at its forward end, as shown in Fig. 5. The pin 85 on the bifurcated arm 82 receives the slotted end of the bar 99 (see Figs. 5 and 24). The outer end of the arm 82 carries a pin 101 to which one end of a pair of return springs 102 is connected, the other end of these springs being attached to the pin or stud 103 on the fixed plate 92. Pivoted to the stud 82[a] on the extension 82[b] of the arm 82 is a link 104, as shown in Fig. 24. The upper end of the link 104 is pivoted to the pin 105 carried by the free end of the arm 106, as best shown in Figs. 5 and 23. The arm 106 is fixed upon the stub shaft 107 journaled in the side 2 of the casing. Fixed upon the same stub shaft is a disk 108 which is provided with a cam 109. As shown in Figs. 5 and 6, this cam consists of two oppositely extending portions which terminate in a point near the periphery of the disk 108. The arm 106, the disk 108 and the cam 109 always rotate in unison as one rigid piece. On the side nearest the casing the disk 108 carries a roller 110, as shown in Figs. 6 and 23. A bracket 111 is secured upon the side 2 of the casing in proximity to the disk 108. This bracket is provided with a race-way 112 curved in the arc of a circle eccentric to the center of the disk, as best shown in Fig. 6. The race-way 112 is in alinement with the disk 108, as indicated in Fig. 23. A ball 113 is held in the race-way by the disk 108. It will be clear from Fig. 6 that the disk 108 is free to rotate in a counter-clockwise direction (as viewed in that figure), but is prevented from rotating in the reverse direction by reason of the ball 113 becoming wedged between the disk and the race-way. The stub shaft 114 which is secured to the side 2 of the casing has rotatably mounted thereon the arm 115 and the bell crank 116. The arm 115 rests normally in a substantially horizontal position in which it is held by the stop pin 117 engaging the rear end of the arm. The stop pin 117 is carried by the side 2 of the casing. In this position the free end of the arm 115 is adapted to engage the roller 110 when the same is in the position indicated in dotted lines in Fig. 6. An arm 118 is at one end pivoted upon the stud 119 carried by the side of the casing. The free end of this arm is provided with a roller 120 which is adapted to ride on the cam 109, as shown in Figs. 6 and 23. The roller is held against the cam by the spring 121 which has one end attached to the rear end of the arm 118 and the other end to the bell crank 116. A link 122 is at one end pivoted to the pin 123 carried by the lower end of the bell crank 116. The other end of the link 122 is pivoted to the stud or pin 124 on the bell crank 91. A dash-pot 125 is pivoted to the bottom of the casing at 126. The arm 127 which is connected to the piston head of the dash-pot is at its outer end pivoted on the stud 97 carried by the arm 95. By referring to Fig. 5 it will be observed that the arm 79 which is fixed upon the subtracting shaft S S is provided with a pin 128 on which is pivoted the locking dog 129. A spring 130 is at one end attached to the arm 79 and at the other end to the dog 129 for normally holding the rear end of the dog against the stop 131. As seen from Fig. 4 the shaft 73 has fixed thereon a depending arm 132 near the left side 1 of the casing. The free end of the arm 132 is provided with a roller 133 (see Fig. 30) adapted to work in the cam slot 134 of the plate 135 which is pivoted upon the stub shaft 136. A fixed pin 137 operating in the slot 138 limits the movement of the cam plate 135. The normal position of the cam plate 135 is that shown in Fig. 4 and in full lines in Fig. 16. When the cam plate is in this its normal position, the rock shaft 73 is in position to hold the numeral wheels forwardly out of the path of movement of the gear sectors 70, as indicated in Fig. 2. However, when the cam plate is moved upwardly, the cam slot 134 will cause the arm 132 to rock the shaft 73 in a counter-clock-wise direction (as viewed in Figs. 4 and 9). This rocking of the shaft 73 brings the numeral wheels into operative position with respect to the sectors 70. The friction of the connected parts holds the cam plate 135 in elevated position until it is forced down again by mechanism to be presently described. Figs. 3 and 9 show the numeral wheels in operative position. Each of the partitions 14 is at its upper rear end provided with an extension 139 which carries a pin 140 adapted to engage the teeth of the pinions 71 when the numeral wheels are in their inoperative position, as shown in Fig. 2. The numeral wheels are thereby held against accidental movement while out of engagement with the actuating gear sectors 70. The pins 140 furthermore serve to hold the numeral wheels in alinement so that there will be no displacement of the numbers discernible through the side opening. At its lower edge the cam plate 135 is provided with a pin 141 on which is pivoted a hook member 142. A rock shaft 144 extends transversely across the machine near the bottom and is at its ends journaled in the sides of the casing. Associated with the cam plate 135 is the plate 145 which is rotatably mounted on the rock shaft 144. To the upper end of the plate 145 is pivoted the small bell crank 146 which is normally held by the spring 147 in the position in which it is shown in Fig. 16. The free end of the bell crank

146 is recessed to operatively engage the stud 141 on the opposite side of the cam plate, as shown in Fig. 20. It is clear from Fig. 16 that if the plate 145 be rocked counter-clockwise, the bell crank 146 will raise the cam plate 135 to the position shown in dotted lines, thereby moving the numeral wheels into operative position. The plate 145 is provided with a pin 143 to which is pivoted the rear end of the link 148. The front end of this link is pivoted on the pin 149 carried by the segment 150 which is fixed upon the subtracting shaft S S, as best shown in Fig. 4. The adding shaft A S has secured thereto the segment 151. The segment 150 is provided with an arc-shaped locking flange 152, while the segment 151 has an arc-shaped locking flange 153. As seen from Figs. 4 and 24 the arrangement of the locking flanges 152 and 153 is such that when either of the shafts S S and A S is actuated the other shaft is positively locked against operation. Nor is simultaneous operation of these shafts possible, but only one shaft can be operated at a time and the other shaft cannot be operated until the first shaft has returned to normal position. The bell crank 154 is rigidly mounted upon the power shaft P S near the left side of the casing, as shown in Figs. 4 and 7. The upper end of the bell crank 154 carries a stud 155 to which is pivoted the hook member 156. The lower end of the bell crank 154 is provided with a pin 157 adapted to engage the recessed end of the hook member 142 when the bell crank 154 is rotated to operative position.

The operation whereby the actuation of the adding shaft A S and subtracting shaft S S is transmitted to the gear sectors 70 will now be understood and is as follows:

For the sake of illustration let it be assumed that the numeral key k^7 in Fig. 2 has been depressed, this key being representative of the numeral 7. From what has been said before regarding the connection between the numeral keys and the links a^0—a^9, it will be clear that the actuation of the key k^7 throws the link a^7 forwardly so that the setting pin b^7 rests at the base of its slot 35 in the sector 36. At the same time the double bell crank 24 is rocked to draw the depending arm 29 forwardly, whereby the zero pin b^0 is drawn out of the path of movement of the controlling arm 65. Similar operations take place when the keys in the other rows are depressed. That is to say, the depression of a key moves the zero pin to inoperative position and thrusts the connected setting pin rearwardly into the path of movement of the controlling arm 65. After the desired set-up has been made by the actuation of the proper keys and it is desired to enter this set-up as a positive item, the adding lever A L is pulled forwardly to the limit of its movement. This rotates the adding shaft A S in the direction indicated by the arrow on the shaft in Figs. 4 and 5. The arm 78 which is fixed to the shaft A S, transmits the movement of the shaft to the bifurcated arm 82 through the link connection previously described. The arm 82 is therefore rocked forwardly and places the operating springs 88 under tension. During this forward movement of the arm 82 the pin 85 slides in the slot 100 of the link 99. It will be remembered that the link 104 is connected to the bifurcated arm 82 at a point intermediate of said arm. Consequently, when the arm 82 is rocked forwardly the link 104 is raised and rotates the stub shaft 107 on which the disk 108 and cam 109 are rigidly mounted. As the disk and cam rotate in the direction indicated by the arrow in Fig. 5, the roller 120 at the free end of the arm 118 rides over the edge of the cam. The rotation of the disk 108 and cam 109 continues until the pin 110 strikes against the opposed end of the arm 115, as indicated in dotted lines in Fig. 6. The actuated parts have now reached their limit of forward movement and it will be observed that the upper cam point is to the rear of the roller 120, so that the downward pressure exerted on the arm 118 by the spring 121 tends to rotate the cam and disk in the same direction as before. This overcomes the dead center of the arm 106 and when the return springs 102 assert themselves to return the parts to normal position, the rearward pull on the arm 82 will return the disk 108 to its original position in the same direction in which it was actuated by the forward movement of the arm 82. In other words, the back and forth movement of the arm 82 always causes rotation of the disk 108 in the same direction. It is to be observed that the point of connection between the link 104 and the arm 106 is not thrown to the rear of the dead center unless the pin 110 rests against the opposed end of the arm 115. Should the adding lever be released before the pin 110 is in this position, the tendency of the springs 102 will be to rotate the disk 108 in a direction reverse to that indicated by the arrow in Fig. 5. As previously explained, the disk is locked against rotation in this reverse direction by the ball 113. So that the adding lever cannot return to normal position unless it is pulled forwardly to the limit of its movement. The tensioning of the operating springs 88 by the forward movement of the arm 82 rocks the bell crank 91 forwardly. This movement of the bell crank is communicated to the power shaft P S on which the bell crank is rigidly mounted, as previously explained. The rotation of the power shaft P S in the direction indicated by the arrow in Fig. 9 is communicated to the controlling arms 65 and the associated sectors 70. These

members are locked together in pairs by the hook 158 of the arm 65 engaging the pin 159 at the bottom of the sector 70. The hook 158 is pivoted on the pin 160 which extends from opposite sides of the controlling arm. On one end of this pin the link 158 is pivoted while the other end projects into the slot 161 of the sector. The controlling arm 65 and its associated sector 70 remain locked together except when the carry-over mechanism is operated, as will be explained later on. Since the zero pin b^0 was withdrawn when the numeral key of the corresponding row was depressed, the arm 65 and sector 70 are rocked upwardly as one piece by the power shaft until the free end of the arm 65 encounters the setting pin of the actuated key. In the particular example assumed for the sake of illustration the sector 70 in Fig. 9 reaches the limit of its upward movement when the free end of the controlling arm 65 encounters the setting pin b^7. In the same way will the actuating sector of each row of keys be actuated, the extent of upward movement of each sector depending upon the identity of the actuated setting pin. If keys of different numerical values are struck in the different rows, the sectors will move different amounts. This, however, does not interfere with the movement of the power shaft by the operating springs 88, because of the frictional connection between the power shaft and the sectors, as previously explained. If no key is depressed in any particular row, the corresponding sector will be held in locked position by the zero pin engaging the arm 65. The amount of rotation which is imparted to the power shaft by the springs 88 is sufficient to give the sectors the maximum movement required, which is a movement sufficient to rotate the numeral wheels nine spaces at one time. The forward rotation of the power shaft under the action of the springs 88 is also communicated to the bell-crank 154. By referring to Fig. 4 it will be seen that as the lower end of this bell-crank continues to swing toward the left, the pin 157 will come into engagement with the pendent hook member 142 and raise the cam plate 135 to rock the numeral wheels into operative engagement with the sectors 70. The strokes of the different moving parts are so calculated that the bell-crank 154 does not raise the cam plate 135 until after the sectors have reached the limit of upward movement. When the numeral wheels have thus been moved to operative position the parts are ready for return movement. It is at this point that the bell-crank 116 has been rocked sufficiently to bring the pin 162 upwardly against the arm 115 (see Fig. 6), thereby moving this stop arm out of the path of the roller 110 on the disk 108. This releases the disk and the return springs 102 become effective to rock the arm 82 rearwardly to normal position. As previously explained, the return movement of the disk is in the same direction as its forward movement. The return movement of the arm 82 causes the springs 88 to relax. It should be stated that when the bell-crank 91 is rocked forwardly by the tension of the springs 88, the slotted bar 99 is slid forwardly a sufficient distance to bring the rear of the slot 100 against the pin 85 of the bar 82, the latter being at that time locked in its forward position. Consequently, when the arm 82 is free to return to its normal position the pin 85 forces the bar 99 rearwardly to rock the bell-crank 91 back to its initial position. This return movement of the bell-crank 91 causes reverse rotation of the power shaft and downward movement of the sectors 70. It is during this downward or return movement that the sectors actuate the numeral wheels an amount corresponding to the set-up on the keyboard, when the adding lever is operated. When, however, the subtracting lever is operated to enter the set-up on the keyboard in a negative or subtractive direction, the numeral wheels are actuated during the upward movement of the sectors and are out of engagement therewith during the return movement of the sectors. How this is accomplished will be readily understood from Fig. 4. When the subtracting lever S L is operated the segment 150, which is fixed to the subtracting shaft S S, is rocked in a forward direction, as indicated by the arrow in Fig. 4. This rocks the plate 145 forwardly through the link connection 148. As previously explained, this movement of the plate 145 raises the cam plate 135. Therefore the initial forward movement of the subtracting lever causes the numeral wheels to be rocked into operative position. That is to say, the pinions associated with the numeral wheels are rocked to a position in which they engage the teeth of the gear sectors 70. This movement of the numeral wheels into operative position occurs before any motion is imparted to the sectors. By reference to Fig. 5 it will be seen that when the subtracting shaft S S is rocked forwardly, as indicated by the arrow, no movement is imparted to the arm 82 until the hook portion 80 of the short arm 79 (fixed on the subtracting shaft) encounters the pin 81 on the arm 82. It is during this initial movement of the subtracting lever that the numeral wheels are rocked to operative position. During the remaining forward movement of the subtracting lever the bifurcated arm 82 is rocked forwardly to place the operating springs 88 under tension. The parts thereupon operate in the manner above described in connection with the adding lever, except that the numeral wheels are actuated by the sectors during the

upward movement thereof. The plate 145 carries a pin 145ª which engages the hook end of the link 142 and moves the latter forwardly out of the path of the pin 57 on the bell-crank 154, when the plate 145 is rocked forwardly.

It is obvious that when the adding lever is operated the cam plate should not be restored to normal or inoperative position until the actuating sectors 70 have come to rest in their normal position. On the other hand when the subtracting lever is operated, the cam plate must be restored to inoperative position before the parts begin their return movement. The mechanism which restores the cam plate 135 when the adding lever is operated has already been described and includes the hook member 156 which is suspended on the upper end of the bell-crank 154, as shown in Fig. 4. When the bell-crank 154 returns to normal position under the action of the return springs 102, the descending link 156 engages the top of the hook member 142 at a time after the sectors have come to rest and before the adding lever has reached the limit of its return movement. This engagement of the link 156 with the hook member 142 carried by the cam plate 135, forces the latter downwardly to its normal position. The roller 156′ journaled to the side of the casing engages the hooked end of the link 156 and accordingly forces the latter rearwardly out of contact with the link 142 after the cam plate has been restored to its normal position. From Fig. 4 it will be seen that normally the link 156 rests with its free end against the roller 156′. I will now describe the mechanism which causes the restoration of the cam plate 135 to normal position when the subtracting lever is operated.

The plate 145 which is loosely mounted on the transverse shaft 144 and is operatively connected with the subtracting shaft S S through the link 148 (as previously explained), is at its lower end provided with a pin 187. This pin is of considerable length, as shown in Fig. 20. On the pivot stud 188 is mounted the bell-crank 189 to the lower end of which is pivoted the lever 190, having a hook-shaped rear end 191 disposed in the path of travel of the pin 187. A spring 192 is secured at one end to the lever 190 and is at the other end attached to the shaft 193 without, however, interfering with the rotation of the shaft. The tendency of the spring 192 is to hold the hooked end of the lever 191 in the position shown in Fig. 4, the shaft 144 constituting a stop for the lever. From this it will be seen that when the plate 145 is rocked forwardly by the subtracting lever through the connections already described, the pin 187 engages the hooked end 191, and raises the same into the path of movement of the pin 157 carried on the bell-crank 154. This movement of the lever 190 does not substantially alter the position of the bell-crank 189, because the spring 192 holds the rear arm of the bell-crank 189 in substantially the position shown in Fig. 4. It will be remembered that the forward rocking of the plate 145 raises the cam plate 135 to operative position so that the numeral wheels are moved into the path of the sectors before the latter begin their upward travel. When the cam plate 135 has thus been moved to its upper or operative position, the top of the link 142 rests underneath the rear arm of the bell-crank 189. Consequently, when the pin 157 engages the hooked end of the lever 190 and thereby rocks the rear arm of the bell-crank downwardly, the cam plate 135 is forced back to normal position. It should be remembered that the pin 157 does not move the lever 190 forwardly until after the actuating sectors 70 have reached the limit of their upward travel, which occurs just before the parts begin their return movement. In this way it will be seen that the numeral wheels are rocked out of the path of downward travel of the sectors when the subtracting lever is operated.

As best shown in Fig. 24 the sleeve portion 84 is provided with an arm 163 which carries at its end a pin 164. This construction is also shown in Figs. 5 and 6. The sleeve 46 is provided with a downwardly-extending arm 165 which may be an extension of one of the arms 47, as shown in Figs. 28 and 31. The arm 165 is curved rearwardly, as shown in Figs. 5 and 6, and carries at its rear end a pin 166 on which is pivoted the extension 167. A spring 168 coiled about the pin 166 bears at one end on the lug 169 of the extension 167 and at its other end bears against the pin 170 on the arm 165, whereby the spring tends to force the extension 167 downwardly. When the bifurcated arm 82 is rocked forwardly by either the adding or subtracting lever the pin carried by the arm 163 rides along the under surface of the extension 167 and raises the latter. When the arm 82 has reached the limit of its forward movement the pin 164 on the arm 163 is below the recess 171 of the extension. Consequently, when the arm 82 is drawn rearwardly by the return springs 102, the pin 164 engages in the recess 171 and draws the extension rearwardly. This rocks the restoring bar 48 downwardly and restores the actuated keys to original position—provided, of course, that the error keys are in the "E" position, as shown in Fig. 25.

From the above detailed description of the operation of the machine to enter any desired set-up into the numeral wheels by

means of the adding lever if the entry is to be added, and by means of the subtracting lever if the entry is to be subtracted, it will be understood that the numeral wheels are actuated by the sectors 70 only during one movement of the sectors. In the specific illustration of the invention herein set forth the numeral wheels are actuated in a positive direction when in engagement with the sectors during the downward or return movement thereof, and in a negative direction when in engagement with the sectors during the upward or forward movement thereof. It will, of course, be obvious that by simply reversing the order of the numbers on the numeral wheels, positive actuation of the numeral wheels will take place when the sectors engage them during forward movement, and negative actuation will be produced when the sectors engage the wheels during the return or downward movement.

It will be observed that the actuation of the power shaft is not directly due to the operation of the adding lever or the subtracting lever, but is directly effected by the operating springs 88. In order to steady the operation of these springs, I have provided the dash-pot 125 which is connected with the bell-crank 91 through the arm 95 and the link 96 as previously explained. Therefore, no matter how the adding lever or subtracting lever may be drawn forwardly to place the operating springs under tension, the power shaft rotates with a steady and uniform motion, allowing the connected parts sufficient time to properly perform the necessary operations.

Instead of using the subtracting lever to enter a given set-up in a negative direction, the operator may accomplish the same result by depressing the subtracting key S K and operating the adding lever A L. A brief reference to this point was made in connection with the general description of Fig. 1, and I will now describe in detail the mechanism whereby this operation is effected. On the transverse shaft 172 which is rotatably journaled in the sides of the casing, is loosely mounted the sleeve 173. A plan view of this arrangement is shown in Fig. 59. The bell-crank 174 is rotatably mounted upon the shaft 172 between one end of the sleeve 173 and the arm 175 fixed upon the shaft 172, as best shown in Figs. 59 and 60. One end of the sleeve 173 is provided with the rigid arm 176, while the other end of the sleeve has formed thereon the rigid arm 177. The purpose and operation of the arm 175 will be described subsequently in connection with the total-taking operation, which will be explained under a separate heading. The arm 175 is provided with a pin 178 which normally rests against one arm of the bell-crank 174, as best shown in Fig. 60. The arm 174[a] of the bell-crank 174 has pivotally connected therewith the upright lever or bar 179, the upper end of which terminates just underneath the cam plate 135 and rests against the fixed pin or roller 180, as shown in Fig. 4. It has been previously stated that the plate 145 which is operatively connected with the subtracting shaft through the link 148, is rotatably mounted on the transverse shaft 144 (see Fig. 4). On this same shaft is also mounted rotatably the disk 181 spaced a short distance from the plate 145, as best shown in Fig. 20. The plate 181 is provided with a pin 182 to which are pivoted the links 183 and 184. The link 184 is at its other end pivotally connected to the arm 176 of the sleeve 173. The link 183 is at its forward end provided with a slot 185 in which works the pin 186 carried at the end of the forward arm of the bell-crank 174. Referring to Fig. 6 it will be seen that the arm 177 of the sleeve 173 has pivotally joined thereto the upright link 194. The upper end of this link is pivoted to the rear of the lever 195, which is mounted to rotate about the stud 196 fixed to the side of the casing. The forward end of the lever 195 carries a roller 197 arranged to work in the cam slot 198 of the plate 199. The stud 200 carried by the side of the casing forms a pivotal support for the plate 199. The stem of the subtracting key S K is at the lower end thereof pivoted to the plate 199, as indicated at 200′. When the plate 199 is rocked downwardly by the actuation of the subtracting key S K the upwardly curved slot 198 forces the rear end of the lever 195 downwardly, thereby rotating the sleeve 173 in a counter-clockwise direction, as viewed in Fig. 6, and in a clockwise direction as viewed in Fig. 4. This movement of the sleeve 173 rocks the arm 176 rearwardly and through the link 184 causes rotation of the disk 181 in the direction indicated by the arrow in Fig. 4. At the same time the link 183 is drawn rearwardly and rocks the connected bell-crank 174 to lift the upright arm 179. This arm in turn pushes the cam plate 135 upwardly to thereby rock the numeral wheels into operative position. When the disk 181 is rotated by the arm 176, the pin 181[a] on the disk raises the hooked end 191 of the lever 190 into the path of the pin 157 on the bell-crank 154. This function of the pin 181[a] is similar to the function of the pin 187 carried by the plate 145. The disk 181 also carries a short pin 201 extending inwardly (as viewed in Fig. 4), to engage the hook end of the link 142 and move the same out of the path of the pin 157, as the disk 181 rotates in the direction of the arrow. Fig. 20 shows the operative relation of the pin 201 to the link 142. It will now be appar-

ent how, when the subtracting key S K is depressed, the numeral wheels are moved to operative position and the hooked end 191 of the lever 190 is moved into the path of the pin 157 on the bell crank 154. These same preliminary operations take place when the subtracting lever is actuated. When the adding lever is pulled forwardly after the actuation of the subtracting key S K, the numeral wheels are operated by the sectors during the upward movement thereof to subtract the set up on the keyboard, in the manner already described.

Carry-over mechanism, (Figs. 2, 3, 9 and 10.)

The carry-over mechanism associated with the numeral wheels for carrying one unit into a higher order wheel whenever the next lower order wheel completes one revolution, will now be described, special reference being had to Figs. 9 and 10. The carry-over mechanism comprises a plurality of independent sections, there being a section for each numeral wheel. The cross-sectional side view shown in Fig. 9 illustrates one of these sections, while the edge view shown in Fig. 10 illustrates two sections. Each carry-over section includes a pair of plates 202 and 203. The plate 202 is of the shape best shown in Fig. 2 and is longer than the companion plate 203, the form of which is best shown in Fig. 9. The plates of each pair are rigidly connected together by the transverse studs 204 and pivot studs to be presently referred to. The longer plate 202 is provided with a slot 205 at its forward end for engaging the shaft 18 which is fixed transversely of the machine casing. The rear upper end of the plate 202 is provided with a rounded slot 206 for engaging the fixed shaft 207 secured to the sides of the casing. The upper end of the shorter plate 203 is provided with a rounded slot 208 in alinement with the slot 206 of the companion plate so as to engage the shaft 207. From this it will be seen that each pair of plates is removably supported on the shafts 18 and 207. Furthermore, each section of the carry-over mechanism is independent of the other sections, so that any one pair of plates may be removed without disturbing the other pairs. In Fig. 9 I have indicated the long plate which is behind the short plate 203, by the reference numeral 202′ to indicate that this long plate is not the companion plate of the short plate 203, but is one of the plates of the next pair. In Fig. 10 the reference numeral 203′ indicates the short plate which forms the companion of the long plate 202′. Between each pair of plates is mounted a stud 209 on which is pivoted the double bell-crank 210 provided with the four arms 210^a, 210^b, 210^c, and 210^d, best shown in Fig. 9. A spring 211 is at its upper end attached to the pin 212 carried by the plate 202. The lower end of the spring is secured to the arm 210^a, the normal tendency of the spring being to rock the double bell-crank counter-clockwise as viewed in Fig. 9. This tendency of the spring is counteracted by the stop shaft 213 against which the rear end of the arm 210^a abuts. The stop shaft 213 is mounted between a pair of arms 214 secured to the rock shaft 215, which is journaled in the sides of the casing. The arrangement of the arms 214 on the shaft 215 is perhaps best shown in Fig. 7 from which it will be seen that the shaft 213 runs clear across the carry-over sections and forms a common stop for all of the bell-cranks 210. Fig. 7 also shows the rear edges of the plates 202 and 203, together with the springs 211. The downwardly-extending arm 210^b of the double bell-crank has joined thereto one end of the link 216, which is at its other end connected to the locking dog 158. On the stud 217 carried by each section, is pivotally mounted the bell-crank 218. To the pin 219 carried between the section plates, is attached one end of the spring 220 which is at its other end connected to the bell-crank 218 to normally hold the arm 218^b of the bell-crank against the stop lug 221 mounted between the plates 202 and 203. The arm 210^c of the double bell-crank 210 is provided with a lateral flange 222 adapted to engage the projection 223 of the arm 218^b. The bell-crank 210 is therefore locked against movement either as long as the projection 223 is in the path of the flange 222 or as long as the stop shaft 213 engages the rear arm 210^a. There is an arm 74 adjacent to each numeral wheel, as previously described, and as shown in Figs. 10 and 30, these arms forming the supporting means for the shaft 72 on which the numeral wheels are rotatably mounted. Each arm 74 has slidably mounted thereon the trip rod 224 adapted to reciprocate in guide pieces 225 on the arm. The lower end of the rod 224 is provided with a roller 226 adapted to engage the periphery of the carry-over disk 227 rigidly secured to the numeral wheel so as to rotate therewith. The disk 227 is provided with a pointed cam projection 228 adapted to raise the trip rod 224 and thus rock the bell-crank 218 to release the shoulder 223 from the flange 222 on the bell-crank 210. The angular disposition of the cam projection 228 with respect to the numbers on the numeral wheels is such that it raises the trip rod 224 when the numeral wheel is passing from the "9" to "zero" position, as observed through the sight opening. The rock shaft 215 has secured near the right end thereof the actuating arm 229, as shown in Figs. 5, 6, and 7. Near the right end of the rock shaft 144, previously referred to, is rotatably mounted the sleeve member 230 provided with the angularly arranged arms 231 and 232, so that the member

230 may properly be considered a bell-crank. The free end of the arm 232 is notched or slotted as indicated at 233 to receive the pin 234 carried at the forward end of the bell-crank 91. A link 235 is at its upper end pivoted to the arm 229 and at its lower end to the arm 231, as best shown in Figs. 5 and 6. By virtue of this connection between the bell-crank 91 and the rock shaft 215, the forward rotation of the bell-crank (as explained in the preceding chapter) causes rocking of the shaft 215 in the direction indicated by the arrow in Fig. 6 and by the arrow in Fig. 9. The reason why the arrows in these two figures indicate reverse directions is due to the fact that Fig. 6 shows a view looking toward the right side of the machine, while Fig. 9 shows a view looking toward the left side. When, therefore, the power shaft P S is actuated upon operation of either the adding lever A L or the subtracting lever S L, as previously set forth in detail, the stop shaft 213 is moved out of engagement with the arm 210ᵃ of the double bell-crank 210. However, no movement of the bell-crank results until the shoulder 223 on the bell-crank 218 is moved out of the path of the flange 222 on the arm 210ᶜ. Whenever a numeral wheel passes from "9" to "zero" position the cam projection 228 trips the bell-crank 218 and allows the double bell-crank 210 to be rocked counter-clockwise (as viewed in Fig. 9) by the spring 211. This withdraws the dog 158 from the pin 159 on the sector 70. Because of the frictional mounting of the controlling arm 65 and the sector 70 on the power shaft P S, this unlocking of the sector 70 from the controlling arm 65 does not interfere with the synchronous movement of these two members until the controlling arm strikes the actuated setting pin. This arrests further movement of the controlling arm 65 and permits an additional one-space movement of the sectors 70 because of the slotted connection between the arms 65 and the sectors 70. By reference to Fig. 9 it will be observed that the pin 160 on the controlling arm 65 is normally in the center of the slot 161 on the sector. The slot is of such length that the additional movement of the sector just referred to gives the connected numeral wheel a one-space rotation—that is to say, the numeral wheel is rotated the distance of one tooth of the gear 71. There being ten teeth on this gear, a one-tooth rotation thereof enters one unit in the numeral wheel either in a positive or in a negative direction. Since the pin 160 of the arm 65 is normally in the center of the slot 161 the additional one-space movement of the sectors 70 can take place in either direction, so that the carry-over mechanism operates indifferently in the positive direction as well as in the negative direction. This feature is of high importance because it enables the machine to add and subtract with equal facility. The pointed cam projection 228 operates the same in either direction. It should in this connection be noted that the carry-over mechanism of a numeral wheel of lower order controls the locking connection between the controlling arm 65 and gear sector 70 of the next higher order. It should also be observed that the carrying into a higher-order wheel does not take place until after that wheel has been actuated the number of units indicated by the depressed key of that order. For instance, if the numeral wheels indicate 1748 and the number 362 is to be added, the units wheel is the first one to pass from the "9" to the "zero" position. In doing so it unlocks the sector of the tens wheel. The hundreds wheel is the next to pass from "9" to "zero" position, thereby unlocking the sector of the thousands wheel, and permitting that sector to give the thousands wheel a one-space advancement. The tens wheel which is actuated six spaces is the last one to pass from "9" to "zero." The hundreds sector does therefore not receive its one-space carrying movement until the tens sector has moved through five spaces. When the tens sector has moved through six spaces the associated controlling arm is stopped by the "6" setting pin, but the sector moves one additional space because of its having been previously unlocked from the controlling arm by the cam projection of the units wheel. The indication of the numeral wheels will therefore be 2—1—1—0. In the same manner does the carrying mechanism operate when a given set up is entered negatively in the numeral wheels, except that instead of one unit being added into a wheel of higher order, one unit is taken out of the numeral wheel.

Each sector 70 carries a pin 232ᵇ adapted to be engaged by the hook arm 232ᵃ mounted on the shaft 144. This arrangement holds the sectors in strict alinement.

From the preceding description it will be seen that my novel form of carry-over mechanism is of exceedingly simple construction as compared with carry-over mechanisms heretofore employed, is positive in its operation and is furthermore capable of working in a positive as well as in a negative direction. In some of the adding machines heretofore constructed it has been necessary to employ two sets of carry-over mechanisms to enable the machine to perform adding and subtracting operations. This necessitated the provision of additional appliances for throwing one set of carry-over mechanism into operative position for adding and throwing the other set into operation for subtracting. I have successfully avoided all of these complications by the single carry-over mechanism above set forth. In addi-

tion to the above noted features which characterize the carry-over mechanism of my invention, there is the feature of dividing the mechanism at any point into two or more independently operative sections. To promote clearness of description, however, I have reserved the detailed description of this last-mentioned feature for a subsequent chapter. The next in order for description is the printing mechanism mounted at the rear end of the machine.

Printing mechanism, (Figs. 34 to 66.)

Briefly stated, this mechanism comprises a platen for supporting the record sheet in printing position, arms carrying the printing type and adapted to be actuated simultaneously with the gear sectors 70, hammers for striking the type to print the entry, platen-controlling mechanism and ribbon shifting mechanism. In addition to this the printing mechanism includes a special means for printing explanatory characters, but in order to avoid possible confusion I will omit this special printing means from this chapter and describe it in detail in a separate chapter later on. Also the mechanism which I have devised for splitting the printing hammers into independently operative sections is omitted from this heading and will be set forth in a subsequent portion of the specification.

The sides 1 and 2 of the machine casing are at the rear cut out to form extensions 236 (see Figs. 3 and 6) to which are secured the plates 237, of the form best shown in Fig. 37, the recessed portion 238 of each plate fitting over the extension 236. Suitable fastening means such as screws 238 hold the plates in position on the casing. The side plates 237 are connected together by the transverse plate 239, as shown in Figs. 34 and 37. The upper and lower edges of this transverse plate are provided with grooves or channels 240 which coöperate with corresponding channels 241 on the slidable platen carriage to form race-ways for the bearing balls 242. The structure of the slidable carriage includes a transverse plate 243 having secured thereto an upper bar 244 and a lower bar 245. As seen in Figs. 35 and 37 these bars extend over the plate 239 and provide the support for the slidable platen carriage on the stationary plate 239. The bar 244 is at its ends provided with a pair of forwardly projecting arms 245ᵃ which serve as bearings for the shaft 246 on which the platen frame is pivoted. The plate 243 is provided with rearwardly and upwardly extending arms 247 which constitute supporting brackets for the shaft 248 on which is journaled a sleeve or roller 249 for carrying the paper roll 250. This is clearly shown in Figs. 6, 34 and 35. On the shaft 246 are mounted the side pieces 251 and 252 of the platen frame. These side pieces form the support for the rotatable platen shaft 253 on which is fixed the platen 254. The left end of the platen shaft 253 (as viewed in Fig. 34) is provided with a cylindrical finger piece 254ᵃ while the right end of the shaft has fixed thereto the large gear wheel 255. The members 251 and 252 of the platen frame carry in their upper extensions the shaft 256 on which is mounted the feed roller 257. On one end of the shaft 256 is fixed the pinion 258 which meshes with the gear 255 on the platen shaft. The object of this arrangement is to produce positive rotation of the feed roller from the platen shaft. In printing mechanism of this class heretofore constructed, the feed roller was adapted to be driven by frictional contact with the record sheet. I have found, however, that when several sheets were used the feeding of the paper was not uniform, the outer sheets slipping with respect to the inner sheets, due to the fact that a feed roller had to depend for its movement merely upon frictional contact with the outer sheet. This difficulty is eliminated by the arrangement which I have just described where the feed roller is positively actuated. The ratio of transmission between the platen shaft and the feed shaft is such that the surface speeds of the feed roller and the platen are equal. This compels all of the sheets to travel uniformly. A serrated cutting bar 259 is secured to the side pieces 251 and 252, as shown in Figs. 35 and 36. This bar is so arranged that the paper which has been fed from the platen passes below the cutting edge, so that when it is desired to sever a printed section of paper it is only necessary to pull the printed section forwardly, whereby it will come into engagement with the serrated edge of the printing bar and be severed. Fixed upon the platen shaft 253 near the left end thereof (as viewed in Fig. 34) is the ratchet wheel 260. A bell-crank 261 is rotatably mounted on the platen shaft 253 adjacent to the ratchet wheel 260. Mounted at the other end of the shaft 253 beside the platen is an arm 262, as shown in Fig. 36. The bell-crank 261 and the arm 262 are connected together by the rock shaft 263 which extends transversely across the machine. To the upper end of the bell-crank 261 is pivoted the lever 264, the point of pivot being indicated at 265. The lever 264 is in the form of a bell-crank, one arm being in the shape of a pawl 266 adapted to engage the teeth of the ratchet 260. The other arm of the bell-crank 264 terminates in a finger piece 267. To the stud 268 on the side piece 251 is pivoted the retaining dog 269 which is normally held against the teeth of the ratchet by the spring 270, secured at one end to the stud 268. The other end of the spring 270 bears against the shaft 256.

The rear end of the retaining dog 269 is provided with a pin or roller 271 adapted to be engaged by the bell-crank 264 when the latter is depressed. A spring 272 secured at one end to the stud 268 and at the other end to the pin 273 on the bell-crank 261, normally holds the latter in the position shown in Fig. 37. From this figure it will be apparent that when the upper end of the bell-crank 264 is depressed the pawl 266 is moved out of contact with the ratchet. At the same time the bell-crank 264 engaging the roller 271 depresses the rear end of the dog 269 and lifts the forward end thereof away from the teeth of the ratchet. Consequently the platen is free to be rotated in either direction by means of the corrugated finger piece 254. I have provided means for automatically rotating the platen so as to bring successive lines into printing position. This operation of the platen is usually termed spacing. Referring to Fig. 6, it will be seen that the arm or lever 274 abnormally rests against the rock shaft 263. The arm 274 is fixed upon the shaft 275 which is pivotally mounted in the sides of the casing. Upon the shaft 275 is also fixed the downwardly extending arm 276 provided with a series of openings 277. A link 278 is at its forward end pivoted to the arm 231 of the bell-crank 230 which, as previously stated, is fixed upon the shaft 144. The rear end of the link 278 terminates in a yoke or bifurcated member 279 which is connected to the arm 275 by the pin 280. It will be remembered that the arm 232 of the bell-crank 230 is operatively connected with the bell crank 91 fixed upon the power shaft P S. When, therefore, the bell-crank 91 is rocked forwardly upon operation of the adding or the subtracting lever (as previously explained) the link 278 is forced rearwardly. This rocks the arm 274 forwardly and operates the bell-crank 261 in the direction indicated by the arrow in Fig. 37 to advance the platen one space. This operation takes place at the beginning of the forward movement of either the adding or subtracting lever. The amount of spacing may be varied by adjusting the pin connection between the arm 276 and the link 278. The three openings 277 in the arm 276 provide for three different spacings—namely, one-line, two-line, or three-line spacings.

I will now describe the mechanism for shifting the platen transversely of the machine so as to bring the desired column on the record sheet into printing position. Referring particularly to Figs. 34 and 35, it will be observed that the bracket arms 247 carried by the plate 243 carry the pivot studs 281 and 282 to which are pivoted the racks 283 and 284. The rack 283 which may be called the outer rack is provided with continuous teeth 283[a], while the inner rack 284 is provided with sets of intermediate teeth 285, as best shown in Fig. 65. A coil spring 286 wound on the stud 282 bears at one end against the rack 283 and at the other end against the rack 284 to normally force the racks toward each other, as indicated in Fig. 35, without interfering with the independent movement of these racks. The outer rack 283 is at its left end (as viewed in Fig. 34) provided with an upwardly and forwardly extending finger piece 287, while the inner rack 284 is at the same end provided with an upwardly and rearwardly extending finger piece 288. As seen from Figs. 35 and 37, these two finger pieces cross each other at the point of pivot of the racks. The plate 243 has secured thereto a bearing piece 289 for supporting the pin 290. As best shown in Fig. 34, the pin 290 extends through the bearing piece 289 and has at one end secured thereto the lever 291, while the crank arm 292 is fixed to the other end of the pin. The lever 291 is at its upper end bent outwardly to provide a finger piece 293 to which is pivoted at 294 the dog 295. From the left upper edge (as viewed in Fig. 34) of the plate 243 extends rearwardly the sector 296 provided with slots 297 with which the dog 295 cooperates to hold the arm 291 in any of its adjusted positions. The crank arm 292 carries at its free end the pin 298 which extends between the racks 283 and 284. This is clearly shown in Figs. 34 and 35. The plate 243 is at its lower portion provided with a longitudinal slot 299 which is adapted to receive the rollers 300 of the carriage 301. At its upper end this carriage is provided with teeth 302 arranged to mesh with the teeth of either the rack 283 or the rack 284. By means of the lever 291 the racks may be adjusted to bring either one of them into operative engagement with the carriage 301 or to hold both of the racks out of engagement with the carriage. There are thus three different positions to which the racks may be adjusted. The sector 296 is therefore provided with at least three slots. By pressing upwardly on the outer end of the dog 295 the latter is drawn out of engagement with the sector 296 and the arm 291 may be adjusted to the desired position. When the dog 295 engages the left slot (as viewed in Fig. 37), the rack 283 is in engagement with the carriage 301. When the dog is in the middle slot, both of the racks are out of engagement with the carriage. When the dog is in the righthand slot, the pin 284 has forced the rack 283 sufficiently to the rear of the machine to cause the spring 286 to bring the rack 284 into alinement with the teeth of the carriage 301. To the stud 303 at the lower end of the carriage 301 is pivoted one end of the connecting rod 304. The other end of the con-

necting rod 304 is pivoted to the pin 305 carried by the channeled crank arm 306. As best shown in Fig. 49, the pin 305 screws into the block 307 which is slidably mounted on the crank arm. The single end of the pin passes into one of the openings 308 provided on the crank arm, as shown in Fig. 34. As the crank arm is rotated or oscillated by means of mechanism to be subsequently described, the carriage 301 is reciprocated and draws with it the framework on which the platen is mounted, provided either one of the racks 283 or 284 is in engagement with the carriage. The stroke of the carriage may be regulated by changing the position of the pin 305 either toward or away from the axis of rotation of the crank arm 306, according as it is desired to decrease or increase the stroke. I will now describe the purpose of the two rack-bars. Normally the carriage 301 is in engagement with the rack bar 284 which, as previously stated, is provided with sets of intermediate teeth 285. As the crank arm is rotated 180 degrees from the position shown in Fig. 34, the carriage shifts the platen-supporting frame the distance of a column on the record sheet so as to bring an adjacent column into printing position; for instance, if the column which is in printing position with the carriage in the position shown in Fig. 34 is the adding column rotation of the crank arm 306 through an angle of 180 degrees causes the platen to be shifted so as to bring the subtracting column into printing position. After the printing in the subtracting column has been done, the carriage is shifted back to normal position. It will, therefore, be seen that the back and forth movement of the carriage 301 brings alternately one or the other of two adjacent columns into printing position. Suppose that it is desired to bring a second pair of columns into printing position. To do this the operator presses down on the finger piece 288 sufficiently to disengage the teeth of the rack-bar 284 from the teeth of the carriage 301 and shifts the carriage-supporting frame just enough to bring the previously operative set of teeth 285 out of alinement with the teeth on the carriage. The operator may then release the finger piece 288 and the smooth edge 284[a] of the rack 284 will bear against the teeth of the carriage. The platen-supporting frame is then shifted to the right until the next set of teeth 285 come into alinement with the teeth 302 of the carriage. When this occurs the alined teeth snap into engagement with each other and the movement of the platen-supporting frame is arrested. When the operator hears the click of the rack 284 snapping into engagement with the carriage, he knows that the platen has been adjusted to a position in which the desired pair of columns has been brought into the printing field. Referring to Fig. 65, the sets of teeth are spaced apart a distance of two columns. So that when the carriage is in engagement with the first set of teeth, the first pair of columns works in the field of the printing mechanism; when the carriage 301 is in engagement with the second set of teeth 285, the second pair of columns works in the printing field, and so on. Ordinarily the rack 283 with its continuous row of teeth will not be necessary. However, where a record sheet is used having columns of less or greater width than those for which the rack 284 has been designed, the shifting of the platen-supporting frame through a distance equal to the space between adjacent sets of teeth on the rack 284 would not bring the next pair of columns into proper printing position. This contingency is met by the use of the rack 283. Since this rack has a continuous line of teeth at its lower edge the platen-supporting frame may be adjusted to any position with respect to the carriage to bring the desired pair of columns into proper printing position. In this way columns of any width may be brought into the field of the printing mechanism. The rack 283 may therefore be said to supplement the rack 284 to permit the platen to be adjusted in any desired position with respect to the carriage 301.

The mechanism for operating the crank arm 306 is best shown in Figs. 48 to 51 inclusive, to which reference will now be had. The crank arm 306 is rigidly secured to the rear end of the shaft 309 journaled in the standards 310 and 311. A grooved pulley 312 is rotatably mounted on the shaft 309 between the standards. The pulley is recessed and houses the spiral spring 313 which has its outer end secured to the rim of the pulley at 314 and its inner end secured to the shaft 309 by the pin 315. The inner end of the shaft 309 has secured thereto the grooved pulley 316. The bell-crank 154 (which as previously stated is fixed upon the power shaft P S) is provided with a hook portion 317. The sector 318 which is loosely mounted on the power shaft opposite the bell-crank 154 carries a pin 319 which engages the hook portion 317 of the bell-crank 154. One end of a rope or cord 320 is attached to the sector 318 at 321, while the other end of the rope is secured to the grooved wheel 316. Loosely mounted on the power shaft adjacent the sector 318 is the larger sector 322. One end of the rope or cord 323 is attached to the sector 322 at the point 324, while the other end of the rope is fastened to the pulley 312. A pawl 325 is pivoted to the pin or stud 326 which is fixed to the adjacent side of the machine casing. One end of the pawl is provided with a hook 327 which normally engages the

projection 328 on the sector 318. The other end of the pawl 325 carries a transverse pin or roller 329 which works in the slot 330 of the sector 322. The segment 150 fixed upon the subtracting shaft S S carries a pin 331. A lever 332 is at its rear end pivoted to the stud 333 on the sector 322 and is at its other end provided with a slot 334 in which the pin 331 normally rests. On the stud 335 carried by the left side of the casing is pivoted a T-shaped lever comprising an upper arm 336 and a pair of lower arms 337 and 338. A connecting rod 339 is at one end pivoted to the lever 332 and at the other end to the arm 337. A second connecting rod 340 is at one end pivoted to the arm 338 and at the other end to the lever 341 which is pivoted to the stud 333. The free end of the lever 341 is formed into a hooked portion 342 adapted to engage the pin 343 carried by the segment 151. As previously stated this segment is fixed upon the adding shaft A S and is actuated whenever the adding lever is operated. In order to avoid confusion the segments 150 and 151 are in Fig. 48 indicated in dotted lines. The upper arm 336 of the T-shaped lever is provided with a slot 344 in which works the pin 345 carried by the arm 346. This arm is fixed upon the inner end of the stub shaft 347 which is journaled in the bearing 348 in the side 1 of the casing. The outer end of the shaft 347 carries the controlling lever C L. To the side 1 of the casing is fixed the circular strip 349 provided with a series of notches 350^a, 350^b and 350^c. The arm 346 is provided with a hollow portion in which works the pin 351. A spring 352 tends to push the pin 351 outwardly against the strip 349, so that as the arm 346 is rotated the pin 351 will slip into the notches on the strip 349 and hold the arm in any of its adjusted positions. When the arm 346 is in the position shown in Fig. 48 the hook end of the lever 332 is in engagement with the pin 331 carried by the segment 150. When therefore the subtracting lever is operated the lever 332 is pulled forwardly (to the left as viewed in Fig. 48). This rocks the segment 322 and by means of the cord 323 the pulley 312 is rotated to place the spring 313 under tension. The initial movement of the sector 322 draws with it the smaller sector 318 and after slight movement of the sector 322 the forward end of the dog 325 is released from the lug 328. The segment 318 therefore moves rearwardly as the lower arm of the bell-crank 154 is rocked forwardly. It should be observed that the ropes or cords 320 and 323 are wound reversely upon their respective pulleys, as indicated in Figs. 34 and 48. The cord 320 is guided from the wheel 316 to the sector 318 by a roller 353 mounted in a bracket 354 on the side of the casing. This is indicated in dotted lines in Fig. 34. When the sector 318 is thus released from the dog 325, the spring 313 which has been placed under tension by the forward rocking of the sector 322 rotates the shaft 309. This rotation is permitted because the smaller sector 318 is free to move rearwardly and allow the rope 320 to be wound upon the wheel 316 which is fixed to the shaft 309. It should be remembered that during this rearward movement of the sector 318 the hook portion 317 on the bell-crank 154 is moved downwardly out of the path of the pin 319. The downward movement of the sector 318 is arrested when the projection 328 thereon encounters the stop 355 carried by the sector 322. This short rearward movement of the smaller sector 318 is just sufficient to allow the shaft 309 to make one-half a revolution under the action of the spring 313. This rotates the crank arm 306 through a distance of 180 degrees and causes the connected carriage 301 to shift the platen so as to bring the adjoining column (usually the subtracting column) into printing position. When the subtracting shaft S S returns to normal position the sector 322 is pushed back by the lever 332 to normal position. At the same time the return of the bell-crank 154 brings the hook portion 317 into engagement with the pin 319 on the sector 318 and rocks this sector upwardly. During this upward or return movement of the sector 318, the shaft 309 is rotated in the reverse direction for one-half a revolution and the platen is shifted back to its previous position where the adding column is in the field of the printing mechanism. It will thus be seen that by a single operation of the subtracting lever the platen is shifted from the adding column to the subtracting column and brought back to the adding column. This automatic return of the platen obviates any special or additional manipulation of the machine by the operator, as has been necessary in machines heretofore constructed where the platen was shifted at one time and returned at another time. When the arm 346 is shifted to the middle position where the pin 351 engages the notch 350^a, the levers 332 and 341 assume the position indicated in dotted lines in Fig. 48. It will be seen that in this position the two levers are disconnected from their respective segments 150 and 151, so that the platen-supporting carriage is not shifted by either the adding lever or the subtracting lever. When the arm 346 is in the position in which the pin 351 engages the notch 350^b the lever 341 engages the pin 343 on the segment 151 fixed upon the adding shaft A S, while the lever 332 remains out of engagement with the segment 150. With the two levers in this position the operation of the subtracting shaft does not cause shifting of the carriage.

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However, when the adding shaft is operated the carriage is shifted from one column to the next in the manner described above in detail, in connection with the subtracting lever. This shifting of the carriage by the adding lever is demanded in cases where the normal position of the platen is in the subtracting column and the adding column is to the right thereof. Ordinarily the platen operates normally in the adding column and the subtracting column is to the right. In this instance the carriage is shifted to the subtracting column when the subtracting lever is operated. However, when the order of the columns is reversed and it becomes necessary to shift the platen from the subtracting to the adding column, the arm 346 is adjusted to the third of the positions above described, so as to cause shifting of the platen when the adding lever is operated.

I will now describe the printing hammers and the associated mechanism whereby the set-up entered into the machine is printed on the record sheet wound over the platen. This portion of the printing mechanism is shown in Figs. 3 and 7, and is shown in detail in Figs. 38 to 43, inclusive, to which reference will now be had. It will be remembered from the description set forth in the chapter on the mechanism for operating the numeral wheels that the levers 66 terminate at the rear end in the arc-shaped type bars 70′. These bars are provided with radial openings in which type pieces 356 are slidably inserted. These type pieces are held in their normal or initial position by means of a thin yieldable rod 357 which passes through slots in the type pieces. One end of the rod 357 is secured to the type bar 70′ at 358 (see Fig. 9) while the other end of the rod is attached to the spring 359 secured to the lug 360 on the type bar. When the inner ends of the type pieces are struck by the hammers to be presently described, the rod 357 yields sufficiently to permit the outward movement of the type pieces to printing position. The spring 359 at once returns the actuated type piece to normal position when the hammer is withdrawn. It will thus be seen that I have provided a simple and effective means for operatively mounting the type pieces in the type bars. In order to bring the type bars side by side the rear portions of the levers 66 are made to converge as shown in Fig. 7. It will, of course, be understood that the type bars are arranged in printing relation to the platen. The mechanism for actuating the printing type is mounted so as to be readily removable from the casing as one unit or section. This hammer section, as it may be properly called, comprises a pair of side plates 361 and 362. Figs. 2, 3 and 57 show the side plate 361, while Fig. 38 best shows the side plate 362. These side plates are provided with slots 363 for engaging the transverse shaft 364 fixed in the sides of the casing. At their front ends the side plates are provided with slots 365 for engaging the transverse shaft 366. The shafts 363 and 366 therefore form the support for the hammer section. A rod 367 passes through the side plates 361 and 362 at the lower forward ends thereof, as shown in Figs. 2, 3 and 38. This rod also passes through the sides of the machine casing and is accessible from without. On removing this rod the hammer section with its connected parts may be disengaged from the shafts 364 and 366 and removed from the casing through an opening in the bottom thereof. On the shaft 368 mounted in the side plates 361 and 362 are pivoted the hammers 369^a, 369^b, 369^c, etc., being respectively the units hammer, the tens hammer, the hundreds hammer, etc. Fig. 39 which illustrates a portion of the hammer mechanism, shows the units, tens and hundreds hammers; while Fig. 38 shows the tens hammer 369^b in side elevation, together with certain of the associated parts to be presently referred to. The hammers 369 are mounted in alinement with the type bars. For the sake of clearness the units type bar is in Fig. 39 indicated by 70^a, the tens type bar by 70^b, and the hundreds type bar by 70^c. Across the hammer section between the side plates 361 and 362 runs the bar 370 which is slotted to accommodate the hammers. Each hammer carries a transverse pin indicated in Fig. 40 by 371. For the sake of distinction the transverse pin on the units hammer 369^a is indicated by 371^a; the transverse pin on the tens hammer 369^b is indicated by 371^b and the transverse pin on the hundreds hammer 369^c is indicated by 371^c. Viewing the machine from the front the transverse pins 371 extend from the left side of the hammers. With each hammer is associated a Y-shaped trigger, as best shown in Fig. 38. The trigger associated with the units hammer 369^a is marked 372^a; the trigger associated with the tens hammer 369^b, is marked 372^b and so on with the other triggers which are not indicated in the drawings. These triggers are pivoted upon the shaft 373 mounted in the side plates 361 and 362. A strengthening bar 374 runs between the side plates and the shaft 373 rests in a recess in that bar, as shown in Fig. 38. Each hammer is provided with a slot 375 shaped to form a shoulder 376. Each trigger has pivoted at its lower end a lever 377 having a transverse lug 378. The lever connected to the lower end of the trigger 372^a in Fig. 38 is for the sake of distinction indicated by 377^a. The lever connected to the lower end of the trigger 372^b is in Fig. 39 indicated by 377^b. The

free end of each lever 377 rests upon the projection 378ᵃ carried by the arm 379 which is pivotally mounted on the shaft 380. This shaft extends between the plates 361 and 362. A strengthening piece 381 runs transversely between the sections and is provided with grooves or channels in which the shafts 368 and 380 are housed, as is shown in Fig. 38. The strengthening piece 381 is of course slotted to allow movement of the hammers 369 and the arms 379. The strengthening piece 374 is also slotted to accommodate the triggers 372. The transverse lug 378 of the units lever 377ᵃ extends into the slot of the tens hammer 369ᵇ; the tens lever 377ᵇ extends into the slot of the hundreds hammer 369ᶜ, and so on. On the shaft 382 which is fixed in the sides 361 and 362 of the hammer section, are mounted the slotted links 383, one for each hammer. Each link 383 has pivoted thereto a lever 384. This lever is in Fig. 38 indicated by the additional reference character 384ᵃ to show that it is associated with the units type bar 70ᵃ. The units lever 384 is in Fig. 39 indicated by 384ᵃ and the tens lever, namely the lever associated with the tens hammer 369ᵇ, is indicated by 384ᵇ. Each type bar is at its lower end provided with a transverse pin extending toward the right as viewed from the front of the machine. The pin carried by the units type bar 70ᵃ is in Figs. 38 and 39 indicated by 385ᵃ. The pin carried at the lower end of the tens type bar 70ᵇ is in Fig. 39 indicated by 385ᵇ. The pin of the hundreds type bar 70ᶜ is marked 385ᶜ. The free end of the lever 384ᵃ is curved toward the right (as viewed from the front) so as to be in alinement with the pin 385ᵃ of the units type bar. Similarly the free end of the lever 384ᵇ is bent so as to be in alinement with the pin of the tens type bar 70ᵇ, and so on with the other levers 384. A bar 386 extending across the hammer section, is slotted to support the free ends of the levers 384 and hold them in proper alinement with the pins of the type bars. A spring 387 is at one end attached to the rear portion of each lever 384 and is at the other end secured to the associated trigger 372 at the point 388. The transverse shoulder 389 on the lever 384 normally rests against the arm 390 of the Y-shaped trigger 372. The tendency of the spring is to hold the shoulder 389 against the arm 390. To the lower end of each hammer is pivoted one end of a spring 391, the other end of which is secured to the bar 392. This bar is slidably mounted on the guide member 393 pivoted on the shaft 394 which is fixed in the sides of the hammer section. The guide member 393 is provided with hook-shaped extensions 394ᵃ which form guideways for the bar 392, as best shown in Fig. 42. The front end of the bar 392 is provided with an extension 395 adapted to normally engage the front edge of the sliding plate 396. The side plates 361 and 362 are provided with alined slots 397 in which the transverse plate 396 reciprocates. I will now describe the connections whereby the plate 396 is operated. On one end of the shaft 382, which is fixed between the side plates of the hammer section, is rotatably mounted the bell-crank 398 having a lower arm 399 and upper arm 400, and an intermediate arm 401, as best shown in Fig. 45. On the other end of the shaft 382 is rotatably mounted an arm (not shown) in alinement with the arm 400. These two arms are connected by the rods 400ᵃ and 400ᵇ. The purpose of the rod 400ᵃ is to hold the slotted links 383 in proper position on the shaft 382. The purpose of the bar 400ᵃ is to return the links 383 to normal position when the bell-crank 398 is rocked counter-clockwise, as viewed in Fig. 38. Referring to Fig. 2, the lower arm 399 of the bell-crank has pivoted thereto one end of the link 402 which is at its other end secured to the transverse plate 396, as indicated at 403 in Fig. 2. A spring 404 secured at its upper end to the ear 405 of the bell-crank 398 and at its lower end to the machine casing, normally tends to hold the plate 396 at its rearward limit of movement, as shown in Fig. 38. In the fixed bearings 406 and 407 is mounted the shaft 408 in alinement with the shaft 382. On the shaft 408 is loosely mounted the sleeve 409 which at one end is provided with the arm 410 and at the other end with the arm 411. To the pin 412 on the arm 410 is pivoted the lower end of the link 413, best shown in Figs. 45 and 47. The upper end of the link 413 is provided with the slots 414 and 415. The bell-crank 154 which is fixed upon the power shaft P S carries the pin 416 adapted to rest in the slot 414 of the link 413. The arm 411 carries a pin 417 which rests in the slot 418 provided on the intermediate arm 401 of the bell-crank 398. From the above described connection between the power shaft and the bell-crank 398, it will be seen that when the bell-crank 154 is rocked in the direction indicated by the arrow in Fig. 45 when either the adding lever or the subtracting lever is pulled forwardly, the link 413 is forced downwardly. This rotates the sleeve 409 and rocks the connected arm 411 downwardly, whereby the lower arm 399 of the bell-crank 398 is rocked forwardly and draws with it the sliding plate 396. This forward movement of the sliding plate places the springs 391 under tension, as may be seen from Fig. 38.

I will now describe the mechanism which trips the hammers and allows them to be operated at the proper time by the springs

391. On the shaft 419, which is rotatably mounted in the side plates 361 and 362 is fixed the fluted tube or cylinder 420 provided with longitudinal flanges 421 extending radially from the core of the shaft, as best shown in Fig. 38. Each hammer is provided with a tail 422 adapted to be engaged by one of the flanges 421 to hold the hammer in inoperative position. As shown in the plan view in Fig. 47, one end of the shaft 419 extends beyond the side plate 362 of the hammer section and has fixed thereto the disk 423. On the disk 423 are provided a plurality of transverse pins 424 spaced equidistantly from each other, as shown in Figs. 45 and 46. In the specific embodiment illustrated in the drawings the pins on the disk 423 are five in number to correspond with the number of flanges 421 on the cylinder or trip shaft 420. The pins 424 are arranged in longitudinal alinement with the flanges 421. From the sleeve 409 extends the intermediate arm 425. The outer end of this arm carries the pin 426 on which are pivoted the pawls 427 and 428. The pawl 427 has a downwardly extending hook 429 while the pawl 428 has an upwardly extending hook 430. The pawls are arranged in radial alinement with the pins 424. The spring 431 fastened at its ends to the pawls tends to draw the pawls together and thereby hold them against the pins 424. The inward movement of the pawls under the actuation of the spring 431 is limited by the link 432 which is at one end pivoted to the pawl 428 at 433. The pawl 427 carries the perforated lug 434 through which extends the removable pin 435 inserted in the end of the link 432. From the above description it will be apparent that when the arm 425 is rocked downwardly (as explained in the preceding chapter), the hook 429 of the pawl 427 operatively engages one of the pins on the disk 423 and rocks the trip shaft 420 in the direction indicated by the arrow in Fig. 38. This suddenly trips the hammers and allows them to quickly move against the type under the action of the tensioned springs 391—provided the hammers are not otherwise held against actuation, as will presently be described. This sudden movement of the hammers 369 to operative position under the action of the springs 391 produces a sharp blow against the type which is thereby caused to print the proper number on the record sheet through the interposed printing ribbon. When the operative parts return to normal position and the arm 425 is rocked back upwardly, the hook 430 of the pawl 428 operatively engages one of the pins 424 and rotates the trip shaft 420 in the same direction as before to bring the next longitudinal flange 421 into locking engagement with the tails of the hammers. So that at the end of the return movement of the parts the hammers are in the same position as at the beginning of the forward operation of the various parts.

I have already stated that the hammers 369 are provided with transverse pins 371. This pin is normally in engagement with one arm of the associated Y-shaped lever 372. Referring specifically to Figs. 38 and 39, it will be seen that the pin 371^a on the units hammer 369^a rests against the recessed arm of the units lever 372^a. Similarly, the pin 371^b of the tens hammer rests against the recessed arm of the tens lever 372^b. And so on with the other pins and levers. It will be seen that this engagement between a hammer and its lever 372 prevents operation of the hammer unless the lever is tripped to release the pin 371. The normal or zero position of the type bars with respect to the hammers is that shown in Fig. 38. It will be seen from this figure that if the hammer associated with the type bar 70^a be actuated, the zero type 356° will be struck into printing position. It will also be observed from this figure that rearward movement of the units lever 384^a is prevented by reason of the free end of the lever resting against the pin 385^a on the units type bar. Suppose now that the units type bar 70^a has been operated to bring any one of the nine significant figures into printing position. In this case when the units hammer 369^a is released by the trip shaft 420, as previously explained, the pin 371^a rocks the Y-shaped trigger 372^a and at the same time permits the spring 387 to draw the lever 384^a rearwardly. The slotted connection between the arm 377^a and the next hammer in the series, namely the tens hammer 369^b, allows the trigger 372^a to be rocked by the units hammer in the manner described. If the units type bar 70^a is in zero position, as shown in Fig. 38, the units hammer will not operate under the tension of the connected spring 391, even when tripped, because the trigger 372^a is locked against movement by the pin 385^a. What has just been said about the units hammer applies, of course, to all the other hammers. Although a hammer is not actuated by the connected spring when the corresponding type bar is in zero position, I have provided a carry-over mechanism between the hammers, whereby the action of a hammer is transmitted to the hammer at the right. The purpose of this arrangement is to cause the printing of zeros to the right of the last significant figure of an entry, when that figure is in a higher order row. Suppose the number to be printed is 800. The hundreds type bar 70^c will accordingly be operated to bring the figure "8" into printing position, but there will be no operation of the tens and units type bars. When the operating springs 391 have been placed under tension

and the trip shaft 420 actuated to trip the hammers, the only hammer that will be operated by its connected spring 391 is the hundreds hammer 369[c]. The manner in which the tens and units hammers are actuated to print zeros in the tens and units rows, is as follows:

When the hundreds hammer 369[c] is actuated by its connected spring 391 the shoulder 376 engages the transverse lug 378 of the lever 377[b] and shifts this lever rearwardly. This causes the connected trigger 372[b] to rock in a clockwise direction (as viewed in Fig. 38) and to break contact with the pin 371[b] of the tens hammer 369[b]. Being thus released the tens hammer is free to operate under the tension of its connected spring 391 and strikes the zero type of the tens type bar to print a zero in the tens column. The actuation of the tens hammer 369[b] rocks the units trigger 372[a] through the lever 377[a], in the same way that the hundreds hammer rocks the tens trigger. The rocking of the units trigger 372[a] releases the units hammer 369[a] and the latter is actuated by its connected spring 391 to print a zero in the units row. However, the higher order hammers to the left of the hundreds hammer 369[c] are not released for action because the associated triggers 372 are not moved to releasing position. Thus zeros are printed to the right of a significant figure and not to the left.

I will now describe the means for throwing any particular hammer out of operation or "killing" the hammer, as it may be termed in mechanical parlance. On the shaft 394 is slidably mounted the lever 436 by means of the slot 437. The rear end of the lever 436 terminates in a transverse lug 438 which is adapted to engage the cam projection 439 on the guide bar 393 when the lever is pulled forwardly. It is to be understood that there is a lever 436 operatively associated with each guide bar 393. To the forward end of the lever is secured one end of the connecting rod 440 (see Figs. 2, 3 and 38). The other end of each rod 440 is connected to the lower end of a lever H which terminates outside of the casing at the front end of the keyboard, as shown in Figs. 1 and 8. The levers H have already been referred to as the hammer-killing levers in connection with the general description of Fig. 1, as set forth in the foregoing chapter. The levers H are pivoted on the studs 23 carried by the partitions 14, as best shown in Figs. 8 and 25. When the operator pushes any one of the levers H rearwardly the lower end of the lever is rocked forwardly and the connected lever 436 rocks the forward end of the sliding bar 392 downwardly out of engagement with the actuating plate 396. This rocking of the sliding bar 392 into inoperative position is caused by the shoulder 438 on the lever 436 engaging the cam projection 439 on the guide bar 393. In this way it is within the control of the operator to cut out any desired hammer without interfering with the proper operation of the other hammers.

I have also provided means for preventing the release of the triggers 372 by the hammers through the levers 377. To the lower end of each arm 379 is pivoted one end of a rod 441, as shown in Figs. 3 and 38. To the other end of the rod 441 is connected the link 442. The forward end of each of these links is pivotally connected to the lower end of the lever S which projects beyond the top of the keyboard, as shown in Figs. 1, 8 and 25. The levers H and S are arranged in pairs on the keyboard (see Fig. 1), a pair being associated with each row of numeral keys. The levers S which have previously been referred to as the hammer-splitting levers, are pivoted on the studs 23 like the hammer-killing levers H. The keyboard is provided with slots 443 and 444 in which the upper ends of the levers H and S operate. Referring specifically to Fig. 38, it will be seen that if the lever S associated with the units row of keys be operated, the arm 379 is rocked to the left and the shoulder 378 raises the lever 377[a] sufficiently to move the lug 378 into the upper or longer portion of the slot 375 out of the path of the shoulder 376. With the lever 377[a] in this its inoperative position, the operation of the tens hammer 369[b] will not rock the trigger 372[a] and will therefore not release the units hammer to print a zero. In the same way will the hammers be split (as it may be properly termed), at any point by simply operating the corresponding hammer-splitting lever S. The splitting of the hammers is always accompanied by a corresponding splitting of the carry-over mechanism for the numeral wheels. The means whereby this operation is effected will be described under a subsequent heading, together with the purpose and object of the splitting operation.

The levers H and S are normally locked against operation by mechanism best shown in Figs. 8, 22 and 25 to which reference will now be had. To the front of the casing near the lower end thereof, is secured the plate 445 which runs transversely of the casing and is provided with slots 446 for receiving the levers H. The levers S are accommodated in the slots 447. The slots 446 and 447 are of considerable depth, as may be seen from Fig. 22. In their normal position the levers H and S are about half way within the slots. On top of the plate 445 is slidably mounted the locking bar 448 provided with hooks 449. As seen from Fig. 22 each of these hooks is adapted to extend across a pair of slots in front of the levers H and S and thereby prevent operation of the levers. A spring 450 abutting

at one end against the left side of the casing and at the other against the upturned lug 451 of the locking bar, normally tends to hold the bar in locking position. Near its right end the locking bar 448 is provided with a lug 452 to which is pivoted the lower arm of the bell-crank 453. This bell-crank is pivoted to the stud 454 carried by the front plate of the casing. The upper arm of the bell-crank 453 is rigidly connected with the lever H S which projects out of the casing. When the operator pushes down on the lever H S the bell-crank 453 shifts the locking bar 448 to the left. In this position of the locking bar the hooks 449 are withdrawn from the slots 446 and 447 and the levers H and S are free to operate. After the desired lever H or S has been actuated (which is done while the lever H S is held depressed), the operator releases the lever H S and the locking bar moves back to normal position under the action of the spring 450. This locks the actuated lever H or S in operative position. In Fig. 22 the lever H′ is shown in locked operative position, the other levers being locked in unoperated position. To steady the movement of the locking bar 448 a link 455 connects the locking bar with the fixed bracket 456.

I will now describe the ribbon-shifting mechanism which is associated with the printing platen, special reference being made to Figs. 52 to 56, inclusive. The printing ribbon 457 is wound on spools 458 and 459 which are journaled in the side plates 460 and 461 of the frame which supports various parts of the ribbon-shifting and ribbon-reversing mechanism. The side pieces 460 and 461 are at the upper end supported by the shaft 215 and at their lower end rest upon the shaft 364. Slots 463 in the side plates afford a firm seating for the frame on the shaft 364 and at the same time permit the frame to be readily removed from the casing. The lower spool 459 is keyed to the shaft 464 which is journaled in the ribbon frame and extends beyond the sides of the frame. A ratchet 465 is secured to one end of the shaft by the pin 466. On either side of the ratchet 465 is mounted a disk 467 between which is pivoted the pawl 468 on the pin 469. The disks 467 are rotatably mounted on the shaft 464. One side of the spool 459 is provided with a peripheral friction flange 470 which is held against the side piece 461 by the spring 471. This spring is coiled about one of the projecting ends of the shaft 464 and bears at its outer end against the dished washer 472 which is held on the shaft by the pin 473 or any suitable means. The tension of the spring 471 is just sufficient to keep the ribbon taut. The structure shown in Fig. 56 applies equally to the upper spool 458. I will only make special reference to the ratchet 465′ and the pawl 468′ which are associated with the upper spool 458 and correspond to the ratchet 465 and the pawl 468 of the lower spool. The teeth of the ratchet 465 run in a reverse direction to that of the teeth of the ratchet 465′. So that the pawl 468 actuates the ratchet 465 in a clockwise direction (as viewed in Fig. 52), while the pawl 468′ rotates the ratchet 465′ in a counter-clockwise direction. The pawls 468 and 468′ are connected together by the rod 474 which is rigidly secured to the upturned lug 475 of the slidable bar 476. This bar is at its upper end pivoted at 477 to the plate 478 which is pivotally mounted on the stud 479 fixed upon the side piece 460. A pair of segments or half disks 480 are pivoted on the stud 479. To the pin 481 carried by the segments is pivoted the lever 482 having a hooked end 483. A similar lever 484 is pivoted to the pin 485 carried by the segments 480. A spring 486 connected to these levers tends to draw them together against the upturned shoulder 487 formed on the plate 478. The plate 478 is provided with a slot 488 in which works the pin 489 carried at one end of the slotted bar 490 which extends across the ribbon frame and is slidably mounted thereon. The ends of the slotted bar 490 project through slots 491 in the side pieces 460 and 461. A second slotted bar 490′ is slidably mounted in the lower portion of the ribbon frame, the ends of this bar working in slots 491′. In the particular embodiment illustrated, these two slotted bars are each built up of a pair of spaced strips leaving a slot or opening 492 between them. The ribbon 457 is adapted to pass through these slotted bars for a purpose to be presently described. To the ends of the shaft 493, rotatably mounted in the sides of the ribbon frame, are fixed the arms 494 and 495. A link 496 is at one end pivoted to the arm 494 and at the other end is connected to the pin 489 of the slotted bar 490. A similar link 497 is connected at one end to the arm 495 and at the other end to the pin 489^a of the slotted bar 490. The link 498 connects the pin 489 of the slotted bar 490 with the pin 489′ of the slotted bar 490′, while the link 499 connects the pins 489^a and $489^{a\prime}$ at the other end of the bars 490 and 490′, respectively. The rod 474 which connects the two pawls together passes through the perforated lugs 500 and 501 fixed on the side plate 460. The lug 501 also forms a guide for the slidable bar 476. On the connecting rod 474 between the lug 475 on the bar 476 and the stationary lug 500 is mounted the coil spring 502. A similar spring 503 is mounted on the rod 474 between the lug 475 and the stationary guide lug 501. The tendency of the springs 502 and 503 is to hold the lug 475 substantially

midway between the lugs 500 and 501. To the pin 485 on the segments 480 is pivoted the lever 504 having an inturned toe 505 to which is fastened one end of the spring 506. The other end of this spring is secured to the stud 507 carried by the side plate 460. The stud 507 projects at its outer end through the slot 508 in the lever 504. The tendency of the spring 506 is to pull the lever 504 upwardly and thereby hold the segments 480 in either of the two adjusted positions into which they are rocked, as will presently be explained. To the pin 509 fixed on the side piece 460 is pivoted the lever 510 provided with a slotted head 511. The shaft 512 on the free end of the rock arm 214 is arranged to operatively engage the slotted head 511. As previously stated the rock arm 214 is fixed upon the shaft 215 which is operated from the power shaft P S through connections heretofore explained, whenever the adding or the subtracting lever is pulled forwardly. To the slotted head 511 is pivoted one end of the link 513. The other end of this link is pivotally connected to the outer disk 467′ at the point 514. To the pin 515′ on the outer disk 467′, is connected one end of the rod 516, the other end of which is connected to the pin 515 carried by the outer disk 467. From the above description it will be apparent that whenever the arm 214 is rocked rearwardly (to the right as viewed in Fig. 52) the link 513 is pushed upwardly and rotates the disk 467′. This causes the pawl 468′, which is pivoted between these disks and is in engagement with the ratchet 465′, to rotate the upper spool 458 and thereby shift the ribbon. This operation takes place during the initial movement of the adding or subtracting lever. It should be noted that as long as the pawl 468′ is in the operative position, the pawl 468 remains in an inoperative position. The step-by-step shifting of the ribbon by the pawl 468′ winds the ribbon from the spool 459 on to the spool 458. To each of the spools is rigidly secured a piece of tape 517 to which is fastened one end of the printing ribbon by means of an ordinary pin 518 or similar suitable means. I have shown this connection only between one end of the printing ribbon and the lower spool 459, but it is to be understood that a similar connection exists between the other end of the ribbon and the upper spool 458. When the ribbon has been wound off the spool 459 the pin 518 encounters the slotted bar 490′ and carries the same along with it, the slot in the bar not being sufficiently wide to allow the pin to pass therethrough. This movement of the slotted bar 490′ is transmitted to the upper bar 490 through the links 498 and 499. The movement of the slotted bar 490 is in turn communicated to the plate 478 through the slot-and-pin connection previously described. The plate 478 is therefore rocked in a counter-clockwise direction (as viewed in Fig. 52). This causes the shoulder 487 formed on the plate 478 to draw the hooked levers 482 and 484 downwardly until the hook portion 483 of the lever 482 is in the path of travel of the lug 519 on the lever 510. The counter-clockwise rotation of the plate 478 pushes down the sliding bar 476 and with it the connecting rod 474, whereby the upper pawl 468′ is moved away from the ratchet 465′ and the lower pawl 468 is moved into engagement with the ratchet 465. Consequently, when the rock arm 214 is operated the pawl 468 rocks the spool-shaft 464 in a clockwise direction (as viewed in Fig. 52) and the movement of the ribbon is reversed. When the lever 510 returns to normal position for the first time after the reversal of the ribbon operation, the lug 519 engages the hooked end 483 of the lever 482 and rocks the segments or half disks 480 counter-clockwise against the tension of the spring 506. This brings the point of connection 479 between the segments 480 and the lever 504 to the right of a line adjoining the pivot pin 479 and the stud 507 so that the tendency of the spring 506 holds the segments 480 against clockwise rotation. This prevents the springs 502 and 503 from moving the connecting rod 474 out of actuated position. The step-by-step shifting of the ribbon in a downward direction by the pawls 468 continues until the ribbon has been unwound from the spool 458, whereupon the upper pin 518 will move the slotted bars 490 and 490′ downwardly. This rocks the plate 478 in a clockwise direction and shifts the rod 474 upwardly to place the pawl 468′ again in operative position. The clockwise rotation of the plate 478 brings the hooked lever 484 into the path of travel of the lug 519 carried by the lever 510. When, therefore, this lever returns to normal position the lug 519 engages the hooked lever 484 and the segments 480 are rocked in a clockwise direction into the position shown in Fig. 52, thereby holding the rod 474 in actuated position. In passing from one roller to the other the ribbon is guided by the rods 520 and 521 which engage the outer side of the ribbon and at the same time serve as connecting rods for the side plates 460 and 461. The guide bar or plate 521[a] engages the under side of the ribbon.

In the fore part of the specification I have referred to the locking connections between certain special keys on the keyboard and the printing mechanism whereby the machine cannot be operated when the platen is not in proper printing position. I will now describe these connections in detail, reference being had to Figs. 6, 36, 37, 64 and 65. On the side plates 251 and

252 of the platen carriage are formed downwardly extending arms 522. In the sides of the frame 239 is journaled the shaft 523 to which are fixed the arms 524 carrying the locking bar 525, as best shown in Fig. 66. As shown in Figs. 36, 37 and 64 the locking bar 525 is normally in engagement with the arms 522 and thereby prevents rocking of the platen carriage. On the shaft 275, which as previously stated is journaled in the sides of the casing, is rotatably mounted the bell-crank 526. A link 527 is pivoted to this bell-crank at 528 and to one of the arm 524 at 529. On the transverse shaft 530 journaled in the sides of the casing is fixed a spring locking plate 531 which extends upwardly into engagement with the back side of the arms 522. On the shaft 530 is also fixed the depending arm 532. To the pin 533 on the arm 532 is pivoted one end of the rod 534. To the pin 535 on the bell-crank 526 is pivoted one end of the rod 536. Referring to Fig. 6 it will be seen that the plate 537 is pivotally mounted on the stub shaft 538′ fixed to the adjacent side of the casing. The plate 537 is provided with curved slots 538 and 539. The forward end of the rod 534 terminates in a transverse pin 540 which operates in the slot 538, while the rod 536 terminates in a pin 541 which operates in the slot 539. The plate 537 has formed thereon the forwardly extending arm 542 which extends upwardly at its free end. On the pin or stud 544 fixed to the side 2 of the casing is pivoted the locking lever 545 provided at its rear end with a locking shoulder 546. The locking arm 545 is also provided with a transverse lug 543 arranged to be in the path of movement of the upturned end of the arm 542. Referring now to Figs. 35, 36 and 37 it will be seen that on the platen shaft 253 are pivotally mounted the arms 547, one on either side of the platen. Each arm is provided at its rear end with a cam portion 548 adapted to engage the upper edge of the locking bar 525 and move the same downwardly clear of the arms 522 so as to unlock the platen carriage and permit the same to be rocked out of printing position. A spring 549 is connected at one end to each arm and at the other end to the side of the platen carriage whereby the arms 547 are normally held in the position shown in Figs. 36 and 37. The arms 547 terminate each in a finger piece 550 for convenience of manipulation. When the operator rocks the arms 547 in the direction indicated by the arrow in Fig. 36 to unlatch the carriage platen by moving the locking plate 525 downwardly, the link 527 (see Fig. 64) is pushed down and the bell-crank 526 is rocked in a counter-clockwise direction. The rod 536 is thus pushed forwardly and rocks the plate 537 to throw the free end of the arm 542 upwardly against the lug 543 of the locking lever 545. This moves the shoulder 546 of the lever 545 against the roller 110 carried by the disk 108. From the previous detailed description of the disk 108 and its connection with the adding and subtracting levers, it will be remembered that when either the adding or the subtracting lever is operated the disk 108 is rotated in a counter-clockwise direction as indicated by the arrow in Fig. 5. However, with the locking shoulder 546 of the lever 545 against the roller 110 the disk 108 is locked against movement and consequently neither the adding or subtracting lever can be pulled forwardly to operate the machine. From this it will be seen that when the platen 254 has been moved out of printing position, the machine is locked against operation. This prevents the operator from entering an item in the machine without causing the item to be recorded by the printing mechanism. A spring 551 connected at one end to the casing and at the other end to the rod 536 returns the rod 536 to normal position. When the locking bar 525 is moved downwardly out of engagement with the arms 522 of the platen carriage, the spring plate 531 moves forwardly as the carriage platen is lifted, and to a certain extent presses the arms 522 upwardly. In other words, as the platen carriage is raised after being unlatched from the locking bar 525, the spring locking bar 531 follows the movement of the arms 522. This rocks the arm 532 rearwardly and draws the link 534 back until the pin 540 rests in the rear end of the slot 538 of the plate 537. It should be remembered that when the pin 540 is in this position the plate 537 is in the position to which it was actuated by the rod 536. The pin 540 therefore holds the plate 537 in its actuated or locking position and the return of the locking bar 525 does not unlock the machine. If it were not for the locking plate 531 the operator could first unlatch the platen carriage by depressing the bar 525 and then after the locking bar 525 had been returned to normal position, operate the machine with the platen out of printing position, because on the return of the rod 536 the weight of the arm 542 would rock the plate 537 back to normal position and thereby release the locking lever 545. However, the second locking plate 531 locks the plate 537 in actuated position and holds the machine locked even after the return of the locking bar 525. It is therefore impossible to operate the machine when the platen is not in proper printing position. The spring 552 secured at one end to the side of the casing and at the other to the rod 534 returns the latter to normal position.

It may sometimes be desired, however, to operate the calculating wheels without recording the entry by the printing mechanism. To permit this operation I have provided means for rendering the locking action of the spring locking bar 531 ineffective. Referring to Fig. 6 it will be observed that the shaft 18 mounted in the sides of the casing has pivoted thereon the lever 554. To the pin 555 at the free end of this lever is pivoted the special key K as well as the link 556. To the stud 557 fixed in the side of the casing is pivoted the lever 558 which is at its upper end connected with the link 556. The lower end of the lever 558 is in engagement with the lug or block 559 secured upon the rod 534. When the key K is depressed the lower end of the lever 558 is rocked forwardly and carries with it the rod 534. This places the pin 540 of the rod 534 in the forward end of the slot 538 and consequently allows the plate 537 to return to normal position with the rod 536 after the platen carriage has been raised. The notch 560 provided in the stem of the key K engages with the casing and locks the key in depressed position. The return of the plate 537 to normal position allows the rear end of the locking lever 545 to drop, whereby the machine is unlocked and may be operated with the platen out of printing position. The spring 561 is at one end secured to the lug 562 on the lever 554 and at its other end to the key K. This causes the key to snap into locked position when the notch 560 comes into alinement with the top of the casing. As the key K is intended for use only on special occasions and is ordinarily not intended for the operator, I have made the key removable. The lower portion 563 of the key stem is provided with a pin 564. If it is intended that the operator shall not be able to work the machine unless the platen is in printing position, the key K is removed from the machine and would be in the custody of a proper official.

Total-printing and clearing operations, (Figs. 5, 6, 9, 28, 29, 31 and 59.)

I will now describe the operation of the machine when the total is printed or "taken" as it is generally called, and also the operation whereby the calculating wheels are cleared or brought back to zero position. Most of the mechanism by which these operations are accomplished has been described in the foregoing part of the specification. When the operator desires to print the total shown in the numeral keys he first depresses the total key T K and then operates either the adding lever or the subtracting lever. In either case the total is printed. However, when the adding lever is operated in printing the total, the entry in the numeral wheels remains, while the operation of the subtracting lever clears the entry out of the numeral wheels and returns the latter to zero position.

I will first describe the operations that take place when the total key is depressed and the adding lever operated. The total key T K is pivoted to the pin 565 carried by the plate 566 which is secured upon the shaft 45, as shown in detail in Fig. 31. The pin 565 extends over the arm 47 of the sleeve 46 which, as previously described, is rotatably mounted on the shaft 45. On the stud 567 which is fixed to the right side piece of the casing is pivoted the cam plate 568. The link 569 is at one end connected to the cam plate 568 by the pin 570 and at the other end connected to the plate 566 by the pin 571. This is clearly shown in Figs. 5, 6 and 28. The cam plate 568 is provided with a cam slot 572 in which works the pin or roller 573 carried by the arm 574. This arm is rigidly secured upon the shaft 575 which is journaled in the sides of the casing. On the shaft 575 are also fixedly mounted the arms 576. One of these arms is associated with each numeral wheel. Each arm 576 is at its free end provided with a transverse lug or toe 577 arranged in the path of movement of the lug 578 formed on the disk 579 which is secured to one side of each numeral wheel, as by means of rivets. When the arm 576 is in operative position, as shown in full lines in Fig. 29, the toe or shoulder 577 is diametrically opoposite the side opening. Normally the arms 576 are in the position indicated in dotted lines in Fig. 29 and shown in full lines in Fig. 9. In this position of the arms 576 the lugs 578 do not encounter the shoulders 577 and the numeral wheels are free to rotate any amount in either direction. When the total key T K is depressed the plate 566 is rocked forwardly drawing with it the cam plate 568 through the link 569. The rocking of the cam plate 568 from the position shown in Fig. 6 to the position shown in Fig. 28, rocks the arm 574 to the position shown in full lines in Fig. 28 in the direction indicated by the arrow. This rocks the shaft 575 in a counter-clockwise direction (as viewed in Figs. 28 and 29) and throws the controlling arm 576 into operative position. The total key T K is held in depressed position by the bell-crank 580 pivoted on the stud 581 which is fixed to the side 2 of the casing. The link 569 is provided with an enlargement 582 which at its rear end terminates in a shoulder 583. When the total key is in its elevated or normal position the front arm of the bell-crank rests on the enlargement 582, as shown in Fig. 6. When, however, the total key is depressed and the link 569 drawn forwardly, the bell-

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crank snaps into engagement with the shoulder 583 and prevents the return of the total key T K. To the pin 584 on the bell-crank 580 is pivoted the pawl 585. A spring 586 is at one end fastened to the bell-crank 580 and at the other end to the pawl 585 to force the free end of the bell-crank upwardly and at the same time hold the dog 585 against the stop pin 587, which is fixed to the casing. The spring 588 secured at one end to the link 569 and at the other end to the pin 589 on the casing, tends to draw the link 569 rearwardly and thereby return the total key to normal position. To the pin 590 on the link 569 is pivoted one end of the link 591, the other end of which is pivoted at 592 to the arm 593 rigidly fixed upon the rock shaft 172. This is best shown in Figs. 28 and 59. As previously explained, the shaft 172 runs transversely of the machine and is journaled in the sides of the casing. It will be remembered that on the shaft 172 is also rigidly mounted the arm 175 provided with the pin 178 which rests against the bell-crank 174, as best shown in Fig. 60. From this it will be clear that when the link 569 is drawn forwardly on depression of the total key, the shaft 172 is rocked forwardly in the direction indicated by the arrow in Fig. 60. The pin 178 rocks the arm 174^a of the bell-crank 174 upwardly and raises the vertical arm 179. As previously explained the upward movement of the arm 179 raises the cam plate 135, whereby the shaft 173 is rocked to move the numeral wheels into operative position, as shown in full lines in Fig. 29. When, therefore, the adding lever is pulled forwardly, the sectors 70 operate the numeral wheels (as heretofore explained in detail) until the lugs 578 encounter the shoulders 577 on the arms 576. The angular position of the lugs 578 with respect to the numbers on the numeral wheels is such that when the lugs engage the shoulders 577 the numeral wheels stand in zero position as seen through the sight openings. It will thus be seen that in the operation just described each sector is moved upwardly to rotate the associated numeral wheel backwardly to zero position. Consequently, the amount of downward movement of each type bar 70′ (see Fig. 9) is proportional to the figure or digit cleared out of the corresponding numeral wheel by the connected sector, and the number printed will correspond with the number taken out of the numeral wheels. When the adding lever returns to normal position under the action of the return springs 102 (as previously explained), the numeral wheels remain in engagement with the sectors 70 and are rotated in the reverse or positive direction the same amount that they are rotated in the negative direction during the upward movement of the sectors. The total is thus retained in the numeral wheels when the adding lever is used in the total-taking operation.

If it is desired to clear the machine when the total is taken, the operator uses the subtracting lever after depressing the total key T K. Under these circumstances the operation is precisely the same as that described in connection with the adding lever, except that during the return movement of the sectors the numeral wheels are out of engagement therewith and are thus left in cleared position. This movement of the numeral wheels to inoperative position during the downward movement of the sectors 70 when the subtracting lever is operated, has been described in detail in the foregoing portion of the specification and need not therefore be repeated here. It will be seen from the above that I have provided very simple means for clearing the machine and that this clearing takes place in one operation with the printing of the total.

The total key controls the locking mechanism of the platen so that it is impossible to clear the machine without printing the number cleared. Referring to Fig. 28 it will be seen that one end of the rod 594 is connected to the arm 593 by means of the pin 595 which works in the slot 596 provided at the forward end of the rod. As shown in Fig. 64 the rear end of the rod 594 is pivoted to the pin 597 on the upper arm of the bell-crank 526. When the total key T K is depressed and the arm 593 rocked forwardly the pin 595 on that arm is moved to the forward end of the slot 596. This prevents rearward movement of the rod 594 and consequently locks the bell-crank 526 against counter-clockwise rotation, (as viewed in Fig. 64). As a result the locking bar 525 is held against downward movement and it is impossible for the operator to unlatch the platen carriage. In this way lifting of the platen carriage is prevented when the total button has been depressed. The total key also locks the keyboard against operation so that it is impossible for the operator to set up on the keyboard a fictitious total. As best shown in Fig. 31 it will be seen that when the total key is depressed the pin 565 forces the restoring bar 48 downwardly over the toes 44 of the error keys E K. This, as previously described in detail, prevents rearward shifting of the restoring plates 25 and thereby prevents operation of the numeral keys.

In order to permit the operation of the sectors 70 when the total is taken it is of course necessary that the zero pins b^o be withdrawn from the path of movement of the controlling arms 65. This is automatically accomplished when the total key T K is depressed through the following connec-

tions. To the rock shaft 45 is fixed the arm 598 between the plate 566 and the adjacent arm 47, as best shown in Figs. 31 and 32. Adjacent the other arm 47 is the arm 599, also fixed upon the shaft 45. The arms 598 and 599 are connected together by the rod or roller 600. The plate 566 is provided with a lateral lug or shoulder 601 adapted to engage the arm 598. As seen from Fig. 2, the depending arms 29 which are rotatably mounted on the studs 23 fixed to the partitions 14, (as previously explained), extend into the path of movement of the roller 600. When the plate 566 is rocked forwardly on depression of the total key T K, the lug 601 rocks the roller 600 forwardly and with it the arms 29. Since the zero rods a^0 are connected to the arms 29 the forward movement of these arms withdraws the zero pins b^0 out of the path of travel of the controlling arms 65.

When the subtracting lever is operated in taking the total the cam plate 135 must be released from its elevated position by the bar 179 just prior to the downward movement of the sectors 70. I have provided the following means for tripping the upright arm 179 at the end of the forward stroke of the subtracting lever. An arm 602 is pivoted at one end on the pin 603 carried by the bell-crank 154, as shown in Fig. 4. The forward end of the arm is adapted to rest on the shaft 16. This arm is provided with a lateral pin 604. The arm 179 which is raised when the total button is pressed, is provided with a lug 605. When the arm 179 is in operated or raised position the lug 605 is in the path of movement of the pin 604. The pin is so arranged that it trips the bar 179 just before the pin 157 on the bell-crank 154 encounters the arm 190. When, therefore, the rear arm of the bell-crank 189 is rocked downwardly at the end of the forward movement of the bell-crank 154, the cam plate 135 is free to be pulled down to normal position.

During the return movement of the operated parts the total key T K is automatically restored to elevated position. On the stub shaft 94, which, (as previously explained) is rotatably mounted on the fixed plate 92, (as shown in Fig. 5) is fixed the arm 606. The arm is provided at its free end with a transverse pin 607. As shown in Fig. 28 the pin 607 is adapted to engage the hooked end of the pawl 585 when the shaft 94 is rocked forwardly. Upon return movement of the shaft 94 the pin 607 draws the pawl 585 rearwardly whereby the bell-crank 580 is tripped out of engagement with the link 569. The spring 588 thereupon draws the link 569 rearwardly and raises the total key T K to normal position. During the rearward movement of the pawl 585 the shoulder 608 thereon rides under the pin 587. This forces the hooked end of the pawl 585 out of engagement with the pin 607, leaving the arm 606, the pawl 585, and the bell-crank 580 in the position shown in Fig. 6.

Item-storing mechanism, (Figs. 3, 4, 15, 17, 18, 19, 67, 68 and 69.)

Next in order of description is the item-storing mechanism whereby an item or entry may be stored in the machine without in any way interfering with the normal operation of the machine and whereby the stored item may subsequently be entered into the numeral wheels. As shown in Fig. 3 there is a support 609 secured to the bottom of the machine casing. This support extends upwardly and has firmly seated thereon the lower end of the sector plate 610, the slot 611 of this plate receiving the upper end of the support. This is also shown in Fig. 67. The upper end of the sector plate 610 is provided with a slot 612 for receiving the fixed shaft 18. In this way the plate 610 is rigidly held in place by the shaft 18 and the support 609. It is to be understood that there is one of these sector plates for each row of numeral keys, but as the connected parts associated with each sector plate are the same for all of the plates, it will not be necessary to describe in detail more than one of the sector plates and connected parts. Each sector plate 610 is provided with studs 613 which are notched at 614 to receive the movable plate 615 formed on the rear end of the arm 616. The plate 615 has rigidly secured thereto the ratchet sector 617 by means of the studs or pins 618. The ratchet sector 617 is provided with ten teeth numbered 619^0 to 619^9. The plate 615 is provided with an arc-shaped slot 620 in which works the pin 621 carried by the free end of the arm 622. As shown in Fig. 3 the arm 622 is at its rear end formed into a yoke 623. By reference to Fig. 11 it will be seen that each of the sleeve members 58 is provided with an annular groove 624. The purpose of these grooves is to accommodate the yoke-shaped ends 623 of the arms 622. By means of this connection the arms 622 are permitted to slide back and forth without being affected by the rotary movement of the sleeve members 58 which are fixed upon the power shaft P S. On the pin 621 is pivoted the pawl 625 of a width sufficient to span the distance between the ratchet 617 and the fixed plate 610, as best shown in Fig. 68. A spring 626 is at one end connected with the pawl 625 and is at the other end fastened to the lug 627 which raises from the arm 622. The pawl 625 is thus normally held against the teeth of the ratchet by the spring 626. The arm 622 is near its free end provided with a pair of lat-

eral flanges 628, the purpose of which will appear later. The lug 627 terminates in a lateral extension 629 adapted to engage one of the setting up pins b^1—b^9, when the arm 622 is moved rearwardly a sufficient distance. The rock shaft 630, which is rotatably journaled in the sides of the casing, has rigidly mounted thereon a plurality of arms 631, one for each item-storing section—as each of the plates 610 and associated parts may be properly termed. On the pin 632 carried by the free end of each arm 631 is pivoted the front end of the associated arm 616, as shown in Fig. 3. Near the left end of the shaft 630 is fixed an arm 632^a provided at its free end with a roller 633, as shown in dotted lines in Fig. 4. On the stud 634 fixed to the left side of the casing is rotatably mounted the cam disk 635. A face view of this disk is shown in Fig. 18 from which it will be seen that the disk is provided with a cam groove 636. It is in this groove that the roller 633 is arranged to work. The cam disk 635 is provided with the pin 637 to which is fastened one end of the spring 638. The other end of this spring is secured to the pin 639 carried by the side of the casing. The tendency of the spring 638 is to rock the cam disk in a clockwise direction, as viewed in Fig. 4. Rotatably mounted on the stud 634 opposite the cam disk 635 is the arm 640 which is provided with the cam slot 641. The roller 633 of the arm 632 extends into the cam slot 641. The key I R is at its lower end pivoted to the arm 640 by means of the pin 642. When this key is in normal or elevated position the roller 633 rests in the lowermost portion of the slot 641. A spring 643 secured at one end to the key I R and at the other end to the side of the casing tends to hold the key in elevated position. On the stud 644 fixed to the left side of the casing are pivoted the lever 645 and the double bell-crank 646. As best shown in Fig. 19 the vertical arm of the double bell-crank 646 terminates in the hooked portion 645. The upper end of the lever 647 terminates in the fingers 648 and 649 which form a yoke or fork. To the arm 650 of the double bell-crank 646 is fastened one end of the spring 651. The other end of this spring is attached to the pin 652 which is fixed to the left side of the casing. The spring 651 holds the upper end of the bell-crank 646 against the stop pin 653 fixed in the side of the casing. The lever 645, is provided with a transverse flange 654 adapted to engage the bell-crank 646. The spring 655 fastened at one end to the arm 656 of the double bell-crank 646 and at the other end to the extension 657 of the lever 645, holds the flange 654 against the double bell-crank. In the normal position of the parts the finger 649 of the lever 645 rests against the stop pin 653. The arm 656 of the double bell-crank is provided with a transverse pin 658 the purpose of which will be presently explained. A lever 659 is pivoted on the stud 660 secured to the left side of the casing. The rear end of this lever carries a pin 661 to which is pivoted the lower end of the key I K. The spring 662 which is at one end fixed to the casing and at the other end to the rear portion of the lever 659 tends to depress the forward end of the lever. The forward end of this lever is provided with a hook portion 663 and a second hook portion 664. The hook portion 663 is adapted to engage the pin 665 carried by the cam disk 635. The hook portion 664 is adapted to engage the stop pin 653.

The operation of the item-storing mechanism will now be understood from the above description. When the operator desires to store a certain entry or amount indicated by the numeral wheels, he pulls the crank I L forwardly. This crank, it should be stated, is rigidly connected with the shaft 634. This operation of the lever I L rotates the cam disk 635 in the direction indicated by the arrow in Fig. 4, until the pin 665 strikes the fork or yoke of the lever 645. This not only arrests the movement of the cam, but the latter is locked against return movement by the engagement with the pin 665 of the hooked end 647 of the double bell-crank 646. This forward movement of the cam disk rocks the arm 632 and the shaft 630 rearwardly or in a clockwise direction, as viewed in Figs. 3 and 4. The connected arms 616 are thereby pushed rearwardly, which motion is toward the right as viewed in Fig. 3, and toward the left as viewed in Fig. 67. During this rearward movement of the arms 616 the plates 615 slide in the notches of the lugs 613 which are carried by the fixed sector plates 610. Since the pin 621 of the arms 622 engage the slots 620 of the plates 615 the rearward movement of the arms 615 is accompanied by a corresponding rearward movement of the arms 622. This rearward movement of the arms 622 places the lateral flanges 628 into alinement with the pins 160 carried by the controlling arms 625, as previously explained. In other words when the arms 622 are in actuated position the pins 160 are situated in the channels formed by the pairs of flanges 628. It is to be understood that when the arms 622 are thus operated by the forward movement of the crank I L, the controlling arms 65 stand in zero position. It will therefore be seen that the purpose of moving the arms 622 rearwardly is to lock them to the associated controlling arms 65 by means of the pins 160 and the flanges 628. After the crank I L has been drawn forward to the limit of its movement, the total

button T K is depressed and either the adding or the subtracting lever is operated. As explained in detail in the preceding chapter, the depression of the total key and the subsequent operation of the adding lever or the subtracting lever, moves each arm 65 upwardly an amount corresponding to the figure indicated by the associated numeral wheel. The rotation of the controlling arms 65 is accompanied by the rotation of the arms 622 by virtue of the previously described connection between these two sets of arms. As the arms 622 move upwardly the pawls 625 ride up the ratchets 617. The number of ratchet teeth which the dog 625 of a given arm moves upwardly during this item-storing operation is the same as the number indicated by the corresponding numeral wheel. Thus, if the numeral wheel associated with the arm 622 shown in Fig. 67 stood at "8" when the adding or subtracting lever was operated, the dog 625 of that arm will engage the eighth tooth of the ratchet, namely, the tooth marked 619^8. It may therefore be truly said that the item-storing arms 622 set up the number indicated by the numeral wheels. The dogs 625 retain the arms 622 in their actuated position. As the bell-crank 154 reaches the limit of its forward movement the inclined end 666 of the rod 602, which is pivoted to the bell-crank, engages the pin 658 on the double bell-crank 646. The pin rides up on the inclined end 666 and the double bell-crank 646 is rocked in a counter-clockwise direction, as viewed in Figs. 4 and 19. This releases the pin 665 of the cam disk 635 and allows the spring 638 to draw the cam disk 635 in a clockwise direction, as viewed in Fig. 4. This clockwise or reverse rotation of the cam disk rocks the arm 632 forwardly, whereby the arms 616 and 622 are pulled forwardly to their normal position. This moves the flanges 628 out of the path of travel of the pins 160 carried by the controlling arms 65 so that the latter are free to return to normal position during the return movement of the adding or subtracting lever. The arms 622, however, are retained in their actuated position and thus store the item or number indicated by the numeral wheels. The reverse or clockwise rotation of the cam disk 635 is arrested when the pin 665 enters the hook-shaped portion 663 of the lever 659. The choice of the adding or subtracting lever during this item-storing operation depends upon whether the total stored is to be retained in the numeral wheels or whether it is to be cleared therefrom. This is explained in detail in the preceding chapter and need not be repeated at this point.

To enter the stored item into the numeral wheels the operator first depresses the key marked I K. This releases the pin 665 from the lever 659 and permits the cam disk 635 to be rotated in a clockwise direction. While holding the key I K depressed the operator turns the crank I L toward the rear one complete revolution. This rotates the cam 635 one complete revolution in a clockwise direction, as viewed in Fig. 4. The movement of the cam is arrested when the pin 665 again engages the hook portion 663 of the lever 669. It is to be understood that after the crank I L has been given its initial rearward movement the key I K is released so as to bring the hook portion 663 of the lever 659 into the path of travel of the pin 665. During this clockwise rotation of the cam the arm 632 and with it the shaft 630 are rocked rearwardly a greater amount than during the item-storing operation. The connected arms 616 and 622 are therefore shifted toward the rear sufficiently to cause the lateral extension 629 on the arms 622 to draw the alined setting up pins b^1 to b^9 rearwardly into operative position, just the same as if the corresponding numeral keys had been depressed to operate the setting-up pins. It will thus be seen that the rearward operation of the crank for one complete revolution produces an automatic set-up on the keyboard representative of the number which had previously been entered in the item-storing mechanism. This complete revolution of the cam disk 635 is not prevented by the hooked end 647 of the double bell-crank 646, because when the pin 665 engages the finger 648 of the lever 645 the latter is forced to the left by the pin 665. Since the lateral flange 654 is adapted to engage the bell-crank 646, the hooked end 647 is forced to the left simultaneously with the finger 648 out of the path of movement of the pin 665. When the operator returns the crank I L to its initial position by giving it one complete revolution in the reverse direction the arms 622 are drawn forwardly until the dogs 625 encounter the rear edges of the plates 610. This trips the dogs out of engagement with the ratchet teeth and allows the arms 622 to fall to the bottom of the slots 620. The operator then actuates either the adding lever or the subtracting lever according as to whether the stored item is to be entered positively or negatively into the numeral wheels. The operation of the adding or subtracting lever actuates the numeral wheels in the manner previously explained to enter the number which had been stored in the item-storing mechanism.

It should be observed that the item-storing mechanism does not in any way interfere with the operation of the machine to add or subtract any set up made on the keyboard. A number may be retained in the item-storing mechanism for any length of

time and returned into the numeral wheels at any time desired.

Operation of special keys P K and R K, (Figs. 4, 6, 7, 28, 45, 47 and 58.)

By reference to Fig. 6 it will be observed that the printing key P K is slidably mounted on the keyboard between guideways 670 secured to the top of the casing. The stem of the key P K is provided with a cam portion 671 adapted to engage the roller 672 carried at the upper end of the arm 673. The horizontal arm 674 is integral with the vertical arm 673 and the two constitute a bell-crank which is pivoted on the stud 675 carried by the right side of the casing. The horizontal arm 674 is provided with a hooked end 676 adapted to engage the pin 110 on the disk 108 when the arm is moved upwardly. A spring 677 is at its upper end secured to the side of the casing and at the lower end to the horizontal arm 674 and tends to rock this arm upwardly. The key P K is removable from the keyboard. It will be clear from Fig. 6 that when the key is withdrawn, the hooked end 676 is rocked upwardly by the spring 677 into engagement with the pin 110. This positively locks the disk 108 against movement, so that the machine becomes locked against operation. In this way I have provided a very simple means for preventing unauthorized or malicious tampering with the machine. If for instance, the operator wants to lock his machine when he leaves it at noon or at the end of the day's work, he simply pulls out the key P K whereby the machine becomes automatically locked against all operations.

The lower end of the key P K is slotted and is adapted to fit over the pin 678 on the bell-crank plate 679. The stud 680 fixed to the side 2 of the casing affords a pivot for the bell-crank plate 679. The link 681 is at its front end conencted to the rod 556 through the pin 682 carried by the bell-crank 558. The rear end of the link 681 is pivoted to the arm 683 which is fixed upon the rock shaft 684. As shown in Fig. 7 the shaft 684 is journaled in bearings 685 secured to the bottom of the casing. The opposite end of the shaft 684 from that to which the arm 683 is fixed, has rigidly connected thereto the arm 686, as shown in Figs. 6, 45 and 47. The link 687 is at one end pivoted to the arm 686 and at the other end to the arm 688, which is rotatably mounted on the shaft 408, as shown in Fig. 47. A link 689 is at one end joined to the arm 688 and at the other end to the lever 413. A depending arm 690 is rigidly fixed to the side of the casing and is at its lower end provided with a lateral pin 691 arranged in the path of movement of the slot 415 on the lever 413. A spring 692 is at one end connected to the link 681 and at the other end to the upper arm of the bell-crank plate 679. When the printing key P K is depressed the bell-crank plate 679 is rocked forwardly and the spring 692 placed under tension. The spring therefore draws the link 681 forwardly and rocks the shaft 684 in a clockwise direction, as viewed in Figs. 6 and 45. This movement of the shaft shifts the lever 413 away from the pin 416 into engagement with the pin 691. It will be seen from Fig. 45 that this movement of the lever 413 breaks the connection between the power shaft P S and the shaft 419 on which the fluted trip shaft 420 is fixed, whereby the printing hammers are locked against operation. When the printing key is released the spring 692 restores the connected parts to normal position.

The bell-crank plate 679 is at its front end provided with the cam slot 693 in which works the roller 694 carried at the free end of the arm 695. This arm is fixed upon one end of the previously mentioned shaft 193 journaled in the sides of the casing. Near the other end of the shaft 193 is fixed the arm 696, as shown in Figs. 4 and 58. A link 697 is at one end connected to the arm 696 and at the other end to the arm 698 rotatably mounted on the shaft 136. The free end of the arm 698 is provided with the roller 699 which normally rests against the link 142. From the above described connections between the bell-crank plate 679 and the arms 698 it will be clear that when the printing key P K is depressed the arm 695 is rocked forwardly and draws with it the arm 698. This causes the roller 699 to move the link 142 forwardly out of the path of the pin 157 on the bell-crank 154. This prevents the elevation of the cam plate 135 into operative position and the numeral wheels therefore remain in an inoperative position when the power shaft is actuated by either the adding lever or the subtracting lever. In this way it is possible to print a number on the record sheet without entering the same into the calculating wheels. This would be necessary in cases where a number is printed only for identification purposes—as for instance, the number of a freight car or a schedule or the like. Obviously such a number is not to be entered into the calculating wheels. To print such an identifying number the operator has only to depress the printing key P K before operating the adding lever. The advantages and utility of this feature of my invention will be apparent to those skilled in the art and will require no further explanation. It should be observed that the above arrangement dispenses with the necessity of separate or special keys for printing identifying numbers, but the same set of keys is used for making numerical entries in the

numeral wheels and identifying entries on the record sheet.

In addition to the two functions above described, the printing key also performs a third function, namely that of controlling a special printing device to indicate on the record sheet that a printed number is for identification purposes only. For the sake of clearness I have reserved the description of this third function of the printing key P K for a subsequent chapter.

Coming now to the general repeat key R K, the purpose of this key is to render the restoring mechanism inoperative for the entire keyboard so that the same set up may be retained any number of times. Referring to Figs. 6 and 28 it will be seen that the repeat key R K is at its lower end pivoted on the pin 700 carried by the lever 701 which is pivoted to the stud 702 secured to the side of the casing. The rear end of the lever 701 carries a transverse pin 703 adapted to engage the rear end of the hook 167 previously referred to. When the general repeat key R K is depressed, the pin 703 throws the hook 167 upwardly and removes the same out of the path of travel of the pin 164 carried by the arm 163. When therefore the arm 163 returns to normal position, the hook 167 is not actuated and the restoring bar 48 is not rocked downwardly, whereby the depressed keys are not restored to normal position. When the repeat key R K is depressed the slot 704 engages the cover of the casing to hold the key in depressed position. A spring 705 secured at one end to the side of the casing and at the other to the key R K restores the latter to elevated position when the slot 704 is released from the casing.

Operation of splitting carry-over mechanism and printing hammers, (Figs. 1, 9, and 25.)

In a previous chapter I have described in detail how the operation of the levers S splits or divides the hammer section at a point determined by the particular lever which is operated. I will now describe in detail the connections whereby the operation of the lever S also splits the carry-over mechanism of the numeral wheels at a point corresponding to that where the hammer section is split. Referring to Fig. 9 it will be seen that the rod 706 is slidably supported at the rear end on the roller 707 and at the front end on the slotted lug 708 fixed on the plate 202. The roller 707 is supported on the plate 203. It is of course to be understood that each pair of section plates 202 and 203 of the carry-over mechanism has associated therewith a rod 706. The front end of the rod 706 is looped or perforated to receive the downwardly extending end 709 of the rod 702. As shown in Fig. 25 the rod 702 is at its front end pivoted to the associated lever S. Each of the rods 702 is at its rear end provided with an indicating pointer 710. When any one of the levers S is operated the connected rod 702 is pushed rearwardly and with it the rod 706. This places the free end of the rod 706 into engagement with the transverse lug or shoulder 711 formed on the arm 210^d of the double bell-crank 210. This locks the bell-crank of that particular section against actuation, even when released by the rod 213 and the bell-crank 218. The locking of any particular carry-over section also locks the sections to the left by rendering them inoperative because the carrying operation takes place from right to left,—that is to say, from a lower order to a higher order. This was fully explained in the chapter on the carry-over mechanism. When a lever S is operated the pointer 710 on the connected rod 702 is brought into view, as shown in Fig. 1, so that the operator may know at what point the carry-over mechanism and hammer section are split.

I will now describe how the keyboard is divided into two independent sections by the operation of one of the levers S. Let it be supposed that the lever S^6 of the sixth order (see Fig. 1) is operated. This locks the sixth section of the carry-over mechanism and prevents the carrying from the sixth to the seventh section. Or, as viewed in Fig. 1, the locking of the sixth carry-over section prevents the carrying from numeral wheel n^6 to numeral wheel n^7. At the same time the hammer section is split at a corresponding point so as to prevent the hammers to the right of the seventh order hammer from printing zeros. This was fully explained in the chapter on the printing mechanism. To illustrate: Suppose the operator actuates the "3" key in the eighth order; the "6" key in the seventh order; the "1" key in the third order; the "4" key in the second order and the "8" key in the first or units order, and then operates the adding lever A L without operating any of the levers S, the printing mechanism will print this set-up as follows, on the record sheet:

36000148.

The indicating wheels will show the same number. Suppose now that with this same set-up the operator actuates the sixth order lever S^6 and then turns the adding lever. The set-up will now be printed by the printing mechanism as follows:

36 148.

The zeros are not printed in the second instance to the right of the seventh order hammer because the operation of the lever S^6 split or divided the hammer section be-

tween the sixth and seventh order hammers. The indication of the numeral wheels in the second instance will be the same as in the first, because the numeral wheels of the fourth, fifth and sixth order remain at zero in both cases. It will be clear from this that in the particular instance illustrated the machine is split or divided into two independently operable sections. The seventh and eighth order keys can be used for one account and the other rows of keys for the second account. The numeral wheels and printing hammers associated with the seventh and eighth order of keys are not affected by the operation of the other numeral wheels and printing hammers. In the second instance above illustrated the number "36" might be some identifying number—such as the number of the account against which "148" has been entered. To illustrate how the splitting of the carry-over mechanism divides the numeral wheels into two independent sections: Suppose that the carry-over mechanism is split between the sixth and seventh order sections by the operation of the sixth order lever S^6 and that the indication of the eight numeral wheels reads:

36999999.

In this case the righthand section of the numeral wheels, represented by the first to the sixth order wheels, has reached the limit of its capacity and should the operator enter say a "1" into this section of the machine, the first six numeral wheels would each show zero while the seventh and eighth order of wheels would remain unaffected and show "36" the same as before. In effect the seventh order numeral wheel in the example just illustrated is the units wheel of the lefthand section of the numeral wheels. This division of the numeral wheels and printing hammers into independent sections renders it possible to automatically indicate and print the numbers of the items entered into the machine. By rotating the error key E^7 of the seventh order (see Fig. 1) to the "R" or "repeat" position, and depressing the "1" key of the seventh row, the numeral wheels n^7 and n^8 will operate as a counter for automatically counting the items as they are entered into the machine—it being supposed of course that the lever S^6 has been operated to divide the numeral wheels and printing hammers as previously explained. The adjustment of the error key E^7 to the "R" position retains the set-up "1" in the seventh row of keys so that at every operation the numeral wheel n^7 is advanced one unit.

I have not attempted to set forth all of the advantages resulting from the splitting feature of my invention, nor have I thought it necessary to describe all of the various uses to which the invention may be put as a result of this feature, inasmuch as such other advantages and uses will readily suggest themselves to those skilled in the art.

Mechanism for printing explanatory characters, (Figs. 2, 3, 44, 57, 58, 61, 62 and 63, 70 to 74 inclusive.)

I have provided mechanism for printing explanatory characters in connection with certain entries. In the particular embodiment illustrated this special printing mechanism, as it may be called, is operated: First, when a negative item is entered to indicate that the item is to be subtracted; second, when a number is entered which is only for identifying purposes, to indicate that this number is to be eliminated in totalizing the numerical entries; third when a total has been cleared and a new item entered into the numeral wheels, to indicate that the numeral wheels were cleared when that total was taken and that the new item is the first one after a cleared total. Referring to Fig. 44 which shows a face view of the type bar carrying the explanatory characters the "—" is printed adjacent an item whenever the subtracting lever is operated; the "E" is printed whenever the printing key P K is operated to print an identifying number which is not to be entered into the numeral wheels; "▭" is printed whenever a total is cleared out of the numeral wheels, and also in connection with the first item entered after the cleared total.

As shown in Fig. 57 the sector-shaped type bar 712 carries at its free end the three type pieces t^1, t^2 and t^3, representing respectively the three characters shown in face view in Fig. 44. These type pieces are mounted in the bar 712 similar to the type pieces 356 in the type bars 70′, as previously explained in connection with Fig. 9. The lower end of the type bar 712 has connected thereto one end of the spring 713 which is at its other end fastened to a lug on the transverse bar 381. The tendency of the spring 713 is to move the type bar 712 upwardly. A pair of grooved guide rollers 714 are pivoted on studs 715 fixed to the side plate 361 of the hammer section. The type bar 712 is arranged to move between the guide rollers in the arc of a circle. A stud or roller 716 is fixed near the lower end of the type bar 712 to engage the lower arm of the bell-crank 717 which is pivotally mounted on the rod 373 carried by the side plates 361 and 362. The upper end of the bell-crank 717 is adapted to engage the pin 718 on the arm 719 formed at one end of the sleeve 720, as perhaps best shown in Fig. 71. The sleeve 720 is rotatably mounted on the shaft 721 which is at one end supported by the fixed plate 92. A standard 722 fixed to the bottom of the casing forms the support for

the other end of the shaft 721 and the sleeve 720. As shown in Figs. 7 and 71, the fixed standard 722 is situated adjacent the side plate 361 of the hammer section. The rock shaft 723 is at one end journaled in the fixed plate 92 and at the other end in the side plate 361 in the standard 722. The sleeve 724 is rotatably mounted on the shaft 723, the right end of this sleeve (as viewed in Figs. 7 and 71) being journaled in the standard 722. The sleeve 724 is at one end provided with an arm 725 having a hook-shaped end 726 (see Fig. 72). The adjacent end of the shaft has fixed thereto the arm 727 which terminates in a hook-shaped portion 728 having recesses 728[a], 728[b] and 728[c], as best shown in Figs. 62 and 63. The pin 716 on the type bar 712 extends through the side plate 361 and terminates in an extension 729 arranged to engage the hook-shaped ends of the arms 725 and 727. The side plate 361 is provided with an arc-shaped slot 730 (see Fig. 3) for accommodating the pin extension 729. At its other end the sleeve 724 has fixed thereto the arm 731 which carries the roller 732. The same end of the shaft has rotatably mounted thereon the plate 733 having an arm 734 which carries at its free end the roller 735. An arm 736 is fixed upon the shaft 723 between the plate 733 and the arm 731. The arm 736 is at its free end provided with transverse pin 737 arranged to work in the slot 738 on the plate 733. This is best shown in Fig. 72. A plate 733 has formed thereon the extension 739 which carries the pin 740. A pair of arms 741 and 742 are pivoted on the pin 740. These arms are rigidly connected together and operate as one piece. A spring 743 (see Fig. 73) is at one end fastened to the extension 739 and at the other end to the arms 741 and 742 to normally hold these arms in the position shown in Figs. 70 and 72. The extension 739 is provided with a pin 744 which is connected to the slotted end of the link 745, as shown in Fig. 70. The elongated slot 746 formed at the lower end of this link is adapted to engage the pin 744. The upper end of the link 745 is connected to the pin 747 carried at the free end of the arm 748 which is fixed upon the shaft 575. A dog 749 is pivoted on the pin 750 carried by the plate 92. One end of the spring 751 is fastened to the dog 749 while the other end of the spring is secured to the lug 752 formed on the plate 733. The dog 749 is arranged to rest at its free end upon the arm 753 of the plate 733. On the pin 754 carried by the plate 92 are pivoted the bell-cranks 755 and 756 which terminate at their lower ends in cam portions 755[a] and 756[a], respectively. As best shown in Fig. 71 the bell-crank 755 is arranged to engage the roller 732 only, while the bell-crank 756 is arranged to simultaneously engage both of the rollers 732 and 735. A link 757 is at one end connected to the upper terminal of the bell-crank 755 while the other end thereof is connected to the pin 128 carried by the arm 79. It has already been explained that the arm 79 is fixed upon the subtracting shaft S S. A link 758 is at one end joined to the upper terminal of the bell-crank 756. The other end of the link 758 is connected to the free end of the arm 759 which is fixed upon the transverse shaft 193. The arrangement of the arm 759 on the shaft 193 relative to the other arms fixed upon that shaft, is best shown in the plan view of Fig. 58. The trip rod 760 which is pivoted at one end on the pin 85 carried by the arm 82 is provided with the hook portions 760[a] and 760[b]. The sleeve 720 is at one end provided with a pair of arms 761 connected together at their outer ends by the pins 762. The free end of the trip rod 760 is arranged to enter between the arms 761 so as to operatively engage the pin 762 and hold the same in the hook portion 760[a].

The operation whereby the above described connections actuate the special printing device, is as follows:

I will first take up the operation whereby a minus sign is printed when an item is entered by means of the subtracting lever. When the subtracting lever is drawn forwardly the link 757 rocks the bell-crank 755 in a clockwise direction, as viewed in Fig. 70. This brings the cam portion 755[a] into contact with the roller 732 and forces the arm 731 upwardly. This raises the arm 725 through the medium of the sleeve 724 to which the arm 731 and 725 are rigidly connected. The raising of the arm 725 out of contact with the pin 729 of the type bar 712 unlocks the latter for subsequent movement. During the forward movement of the arm 82 by the subtracting lever the trip rod 760 rocks the arms 761 in the direction indicated by the arrow in Fig. 70, and thereby the sleeve 720. The arm 719 which is rigidly connected with the sleeve 720 is therefore rocked in the direction indicated by the arrow in Fig. 57 and the bell-crank 717 is released. This causes the spring 713 to rock the type bar 712 upwardly until the pin extension 729 engages the recess 728[a] of the arm 727, as shown in Fig. 63. In this the first operative position of the type bar 712 the type piece t^1 is brought into printing position to print the minus sign (—). It is to be understood that with the type bar 712 there is associated an actuating hammer the same as with each of the tye bars 70′; as shown in Fig. 38 and described in detail in the foregoing chapter on the printing mechanism. I have not though it necessary to illustrate the hammer associated with the type bar 712 since that would be substan-

tially a duplication of what is shown in Fig. 38. When the printing hammers are operated to print a number set up on the keyboard a minus sign will be printed opposite the number which constitutes the entry. This is indicated at M in Fig. 61 which represents part of a record sheet. During the return movement of the arm 82 the trip rod 760 rocks the arm 719 back to normal position, whereby the type bar 712 is forced down to its original position by the bell-crank 717. The return movement of the type bar 712 does not begin until after the printing hammers have been actuated.

The printing of the character "E" takes place when the printing key P K is depressed to prevent the numeral wheels from being thrown into operation when the adding or subtracting shaft is actuated. As previously stated the printing key P K is used when a number to be printed is not one that enters into the process of addition or subtraction, but is a number for identification purposes only. How the depression of the printing key P K prevents the numeral wheels from being thrown into operative position with respect to the sectors 70 has already been explained in detail in the preceding chapter and need not therefore be repeated at this point. It will only be necessary to describe here how the operation of the type bar 712 is controlled by the printing key. When the printing key P K is depressed the shaft 193 is rocked, through the connections previously described, in the direction indicated by the arrows in Figs. 6 and 70. This rocks the arm 759 forwardly (toward the right, as viewed in Fig. 70), whereby the bell-crank 756 is rocked to throw the cam portion 756ª against the alined rollers 722 and 735. The resultant rocking of the arms 731 and 734 raises the arm 725 out of engagement with the pin 729 on the type bar 712 and simultaneously raises the arm 727 sufficiently to bring the recess 728ᵇ into the path of movement of the pin 729. Consequently, when the type bar 712 is rocked upwardly by the spring 713 on the return movement of the arm 82, as previously explained, the movement of the type bar is not arrested until the pin 729 engages the recess 728ᵇ. When this occurs the "E" type piece t^2 is in printing position, and the character "E" will therefore be printed opposite the entry. Such an explanatory entry is indicated at "X" in Fig. 61.

The total key T K controls the operation of the type bar 712 as follows:

When the total key T K is depressed in adding the total, the arm 574 is rocked in the direction indicated by the arrow in Fig. 28, thereby causing the shaft 575 to rock in the same direction. This movement of the shaft 575 is communicated to the arm 748 as indicated by the arrow in Fig. 70. The connected link 745 is therefore raised, rocking the plate 733 in the direction to throw the extension 739 upwardly. This movement of the plate 733 is transmitted to the shaft 723 through the medium of the pin 737 and the arm 736 which carries the pin and which is fixed upon the shaft 723. The amount of rotation which is thus imparted to the shaft 723 is sufficient to raise the arm 727 so as to bring the recess 728ᶜ into the path of travel of the pin 729. When the subtracting lever is operated after the depression of the total key the arm 725 is raised out of engagement with the pin 729 and the type bar 712 is actuated upwardly, as described in the foregoing portion of this chapter. The upward movement of the type bar 712 continues until the pin 729 engages the outermost recess 728ᶜ of the arm 727. When this occurs the type piece t^3 having thereon the character "▭" stands in printing position. It will be remembered from the description set forth in a previous chapter that when the total key T K is depressed and the subtracting lever then operated, the total indicated by the numeral wheels is printed and at the same time cleared out of the numeral wheels. Every cleared total is indicated by the character "▭", as shown at T in Fig. 61. When the adding lever is operated after the depression of the total key to print the total without clearing the same from the numeral wheels, the type bar 712 is not operated. A retained total is indicated at "R" in Fig. 61. The character "▭" is also used in connection with the first item entered after the total has been cleared. This is done by preventing the return of the locking arm 719 during the rearward movement of the trip rod 760. When the extension 739 on the plate 733 is raised upon depression of the total key, the arm 741 is thrown up into the path of the rod 760. At the same time the arm 753 of the plate 733 is rocked into engagement with the shoulder 763 on the pawl 749, whereby the plate 733 is held in actuated position. As the trip rod 760 moves rearwardly the hook portion 760ᵇ engages the free end of the arm 741, thereby rocking this arm and raising the trip rod 760 out of engagement with the pin 762. This prevents the shaft 721 and consequently the arm 719 from being moved back to original position. When the arm 741 is rotated about the pivot 740 by the trip rod 760, the arm 742 is also raised and comes into contact with the free end of the pawl 749. The latter is thus tripped out of engagement with the arm 753, with the result that the plate 733 drops down to normal position. This also lowers the trip rod 760. When this occurs, however, the hook portion 760ª is moved beyond the pin 762

and continued rearward movement of the trip rod 760 produces no motion of the arms 761. The type bar 712 is therefore left in its previously actuated position. When the next item is entered in the machine the character "▭" is printed the same as when the total was taken and cleared. Such items are indicated at N in Fig. 61.

While I have described and illustrated one specific embodiment of my invention, it is to be understood that various changes and modifications may be made by those skilled in the art without departing from the scope of the invention as defined in the appended claims. Furthermore, it is obvious that certain features of my invention may be used without certain other features.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a calculating machine, the combination of a series of numeral wheels, means for selectively operating the same predetermined amounts, carrying over mechanism, means for printing the amounts indicated by said wheels including means for filling in zeros, means for splitting said carry over mechanism, and means for splitting said zero filling mechanism, said last two mentioned means being operated by a single means.

2. In a calculating machine, the combination of a series of numeral wheels, means for selectively operating the same predetermined amounts, carrying over mechanism, means for printing the amounts indicated by said wheels including means for filling in zeros, and means for simultaneously splitting said carry over mechanism and said zero filling mechanism for the purpose described.

3. In a calculating machine, the combination of a series of numeral wheels, means for selectively operating the same predetermined amounts, carrying over mechanism, means for printing the amounts indicated by said wheels including means for filling in zeros, and means for simultaneously splitting said carry over mechanism and said zero filling mechanism, and means adjustable to a repeat position to cause the repeating of any number depressed in its respective row whereby the numeral 1 may be depressed in the row to the left of the split and the section corresponding to said last mentioned row will act as an automatic counter.

4. In a calculating machine, the combination of a series of numeral wheels, a toothed sector associated with each numeral wheel for operating the same a predetermined amount, a key-controlled arm associated with said sector for controlling the operation thereof, a pin-and-slot connection between each sector and its arm to permit a one-space movement of the sector in either direction independently of the associated arm, means for normally locking each sector and its arm together for simultaneous operation, connections between the numeral wheels and said locking means, whereby a lower-order wheel on passing through zero automatically releases the sector of a higher-order wheel to carry one unit into the higher-order wheel, said connections including a pair of normally interlocked bell-cranks, one of which is connected with the associated numeral wheel and the other with said locking means, so that the numeral wheel trips the connected bell-crank and thereby releases said other bell-crank to render the locking means ineffective.

5. In a calculating machine, a series of numeral wheels each having associated therewith a toothed sector, an arm associated with each of said sectors, and releasable means for locking each of said sectors and its respective arm together, said means comprising a pair of normally interlocked bell-cranks, one of which is arranged to be operated as its associated numeral wheel rotates through zero and in turn release the other bell-crank, a pin-and-slot connection between each sector and its respective arm, the pin being released for movement in said slot by said other bell-crank whereby to permit a one-space movement of said sector with relation to said arm.

6. In a calculating machine, a numeral wheel having a toothed sector associated therewith, a stop nose arm associated with said sector to normally move therewith, a pin and slot connection between said sector and said arm to permit a one-space movement of the sector in either direction independent of said arm, and means including a pair of normally interlocked bell cranks for operating said connection to permit said one-space movement.

7. In a calculating machine, the combination of a series of calculating members, an adding lever for actuating said members in a positive direction, a subtracting lever for actuating said members in a negative direction, and a key for causing said adding lever to actuate the calculating members in a negative direction.

8. In a calculating machine, the combination of a series of calculating members, a pivotally mounted sector associated with each member for actuating the same a predetermined amount, an adding lever for operating the sectors to normally cause positive actuation of the calculating members, a subtracting lever for operating the sectors to normally cause negative actuation of said calculating members, and means for so controlling the operative relation be-

tween the calculating members and the sectors that the operation of said adding lever causes negative actuation of said members.

9. In a calculating machine, the combination of a series of calculating members, a pivotally mounted sector associated with each member for actuating the same a predetermined amount, an adding lever for operating the sectors to normally cause positive actuation of the calculating members, a subtracting lever for operating the sectors to normally cause negative actuation of said calculating members, and a key for so controlling the operative relation between the calculating members and the sectors that the operation of said adding lever causes negative actuation of said members.

10. In a calculating machine, a series of calculating members, pivotally mounted sectors adapted to actuate said members a predetermined amount, means for moving said members into and out of operative relation to said sectors, an adding lever for operating said sectors to normally cause positive actuation of the calculating members, a subtracting lever for operating the sectors to normally cause negative actuation of said calculating members, and a key for so controlling said means that the operation of said adding lever causes the sectors to actuate the calculating members in a negative direction.

11. In a calculating machine, the combination of a series of calculating members, a subtracting lever, an adding lever for operating the same in either direction a predetermined amount, and a pair of keys for controlling the direction of operation of said calculating members by said adding lever.

12. In a calculating machine, the combination of a series of calculating members adapted to be operated in either direction, an adding key for causing the operation of said members in an adding or positive direction, a subtracting key for causing the operation of said members in a subtracting or negative direction, an adding lever, a subtracting lever, and means to effect subtraction upon the operation of the adding lever.

13. In a calculating machine, the combination of a series of calculating members adapted to be operated in either direction, an adding key for causing the operation of said members in an adding or positive direction, a subtracting key for causing the operation of said members in a subtracting or negative direction, and means for so interconnecting said keys that when either one is in its operative position the other is in its inoperative position.

14. In a calculating machine, the combination of a hand lever for operating the machine, a removable key, and means operated solely by the removal of said key to automatically lock said lever against operation.

15. In a calculating machine, the combination of an adding lever, a subtracting lever, a removable key, and means operated solely by the removal of said key to automatically lock both of said levers against operation.

16. In a calculating machine, calculating mechanism, a key-board, a depressible key mounted in said key-board, said key being removable, and means operated solely by the removal of said key to automatically lock said mechanism against operation.

17. In a calculating machine, calculating mechanism including numeral pinions and driving elements therefor, said pinions being movable into and out of engagement with said elements, a removable key, means connecting said key and said mechanism whereby operation of said key will prevent said pinions from engaging said elements, and further means connecting said key and said mechanism to automatically lock said mechanism against operation upon the removal of said key.

18. In a calculating machine, calculating mechanism, a removable key, means connecting said key and said mechanism to hold said mechanism in inoperative position upon the operation of said key, and automatic means operable upon the removal of said key to lock said mechanism against operation.

19. In a calculating machine, calculating mechanism, a removable key, printing mechanism, said key having means connected therewith whereby when the key is operated the calculating mechanism is held in inoperative position and the printing mechanism controlled, and when the key is removed the calculating mechanism is automatically locked against operation.

20. In a calculating machine, calculating mechanism, printing mechanism for printing explanatory characters, a removable key, and means connecting said parts whereby when said key is depressed the calculating mechanism will be held in inoperative position and an explanatory character printed to indicate that fact, and when said key is removed the calculating mechanism will be automatically locked.

21. In a calculating machine, the combination of a printing mechanism including means for supporting a record sheet in printing position, an adding lever for operating said mechanism to print positive items, a subtracting lever for operating said mechanism to print negative items, connections between said supporting means and each of said levers for shifting said supporting means back and forth by a single operation of either lever, and means for

throwing said connections out of operation at will.

22. In a calculating machine, the combination of a pivoted platen-supporting carriage, mechanism for locking said carriage in printing position regardless of whether or not the platen be swung away from printing position, means for releasing the carriage from said mechanism, and means for automatically locking the machine against operation as a calculator when the carriage is unlocked regardless of whether or not the platen be swung away from printing position.

23. In a calculating machine, the combination of printing mechanism including a platen, calculating mechanism, a lever for simultaneously operating said mechanisms to enter a predetermined item, means for automatically locking said lever against operation when the platen is out of printing position, and further means operable upon swinging of said platen away from printing position to lock said lever locking means against release.

24. In a calculating machine, the combination of printing mechanism including a platen, means for locking said platen in printing position, means for releasing said locking means to permit raising of the platen out of printing position, calculating mechanism, a lever for simultaneously operating said mechanisms to enter a predetermined item, and connections between said locking means and said lever, whereby the latter is automatically locked against operation when the platen is moved out of printing position.

25. In a calculating machine, the combination of printing mechanism including a platen, calculating mechanism, means for operating said mechanisms to enter a predetermined item, means for moving said platen out of printing position, and key-controlled connections for preventing such movement of the platen.

26. In a calculating machine, the combination of totalizing mechanism comprising a sector and associated alining gear, a lever for normally actuating the same with said gear and sector intermeshing in both directions by a single operation thereof, carry over mechanism operative upon a single operation in either direction, and means for throwing the gear and sector out of engagement during the return movement of said lever.

27. In a calculating machine, the combination of totalizing mechanism comprising a sector and associated alining gear, transfer mechanism operative upon a single operation of the machine, a lever for normally actuating the totalizing mechanism with said gear and sector intermeshing in both directions by a single operation thereof, and a key for throwing the gear and sector out of engagement during the return movement of said lever.

28. In a calculating machine, the combination of a pivoted platen-supporting carriage, mechanism for locking said carriage in printing position, means for releasing the carriage from said mechanism, means for automatically locking the machine against operation when the carriage is unlocked, and key-controlled connections for rendering said last mentioned means ineffective.

29. In a calculating machine, the combination of printing mechanism including a platen, calculating mechanism, a lever for simultaneously operating said mechanisms to enter a predetermined item, means for automatically locking said lever against operation when the platen is out of printing position, and key-controlled connections for rendering said locking means ineffective.

30. In a calculating machine, the combination of printing mechanism, including a platen, calculating mechanism, means for operating said mechanisms to enter a predetermined item, means for moving said platen out of printing position and key-controlled connections for preventing such movement of the platen, said connections being operable upon depression of the total key.

31. In a calculating machine, the combination of a pivoted platen-supporting carriage, mechanism for locking said carriage in printing position, means for releasing the carriage from said mechanism, means for automatically locking the machine against operation when the carriage is unlocked, connections for rendering said last mentioned means ineffective and a removable key for controlling said connections.

32. In a calculating machine, the combination of printing mechanism, including a platen, calculating mechanism, a lever for simultaneously operating said mechanisms to enter a predetermined item, means for automatically locking said lever against operation when the platen is out of printing position, connections for rendering said locking means ineffective, and a removable key for controlling said connections.

33. In a calculating machine, the combination of calculating wheels, a key-controlled rack associated with each wheel for actuating the same, means for operating said racks to clear the numeral wheels, connections for automatically arresting the movement of each rack when the associated numeral wheel reaches zero position, an arm adapted to be connected with each rack for simultaneous operation therewith, whereby the actuated position of said arms is representative of the item cleared from the numeral wheels, a keyboard, and means for controlling said keyboard by said arms.

34. In a calculating machine, the combination of calculating wheels adapted to receive entries, means for operating said wheels in a negative direction to zero position, mechanism adapted to be operated in accordance with the negative operation of the numeral wheels, a keyboard controlled by said mechanism, and a lever for controlling the operative position of said mechanism.

35. In a calculating machine, the combination of printing mechanism, including a platen-carriage pivotally mounted for swinging movement, mechanism for locking said carriage in printing position and against swinging movement, means for releasing the carriage from said mechanism, means for automatically locking the machine against operation as a calculator when the carriage is unlocked, regardless of whether or not the platen is swung away from printing position, and means operable upon the swinging of said platen away from printing position to lock said calculator locking means against release.

36. In a calculating machine, the combination of printing mechanism, including a platen mounted to swing toward and from the other members of said mechanism, calculating mechanism, means for simultaneously operating said mechanisms to enter a predetermined item, means to lock said platen against swinging and in operative position, means to release said locking means, and means connecting said releasing means and said operating means whereby when said releasing means is operated said operating means is locked against operation, regardllless of the position of said platen, and when said releasing means is returned to normal position said operating means may operate providing the platen is in printing position.

In witness whereof, I hereunto subscribe my name this 9th day of December A. D. 1910.

MARTIN TEETOR.

Witnesses:
CLARENCE J. LOFTUS,
ELIZABETH SKAHILL.

Corrections in Letters Patent No. 1,344,191.

It is hereby certified that in Letters Patent No. 1,344,191, granted June 22, 1920, upon the application of Martin Teetor, of Des Moines, Iowa, for an improvement in "Calculating-Machines," errors appear in the printed specification requiring correction as follows: Page 14, line 4, for the reference-numeral "57" read *157*, and page 23, line 83, for "400^a" read *400^b*; page 30, line 63, for the word "are" read *were;* page 32, line 47, for the reference-numeral "645" read *647;* same page, line 48, for "647" read *645*, and line 117 for "625" read *65;* page 41, claim 22, commencing with the word "regardless," line 6, strike out all to and including the word "position," line 8, and insert the words *and against pivotal movement;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of November, A. D., 1920.

[SEAL.]

L. B. MANN,
Acting Commissioner of Patents.

Cl. 235—60.

DISCLAIMER.

1,344,191.—*Martin Teetor*, Des Moines, Iowa. CALCULATING MACHINE. Patent dated June 22, 1920. Disclaimer filed October 31, 1927, by the assignee by mesne assignments, *Lincoln Accounting Machines Company.*

Hereby disclaims any structure falling within claims 7, 8, 12, and 25 of said patent as set forth more specifically below:

Claims 7, 8, and 12.—Your petitioner hereby disclaims any construction falling within the terms of any of these claims wherein the "adding lever" controls the release of a motor for operating the machine.

Claim 25.—Your petitioner hereby disclaims any construction falling within the terms of this claim, except one wherein the connections for preventing movement of the platen out of printing position are under the control of means for effecting clearing of the machine.

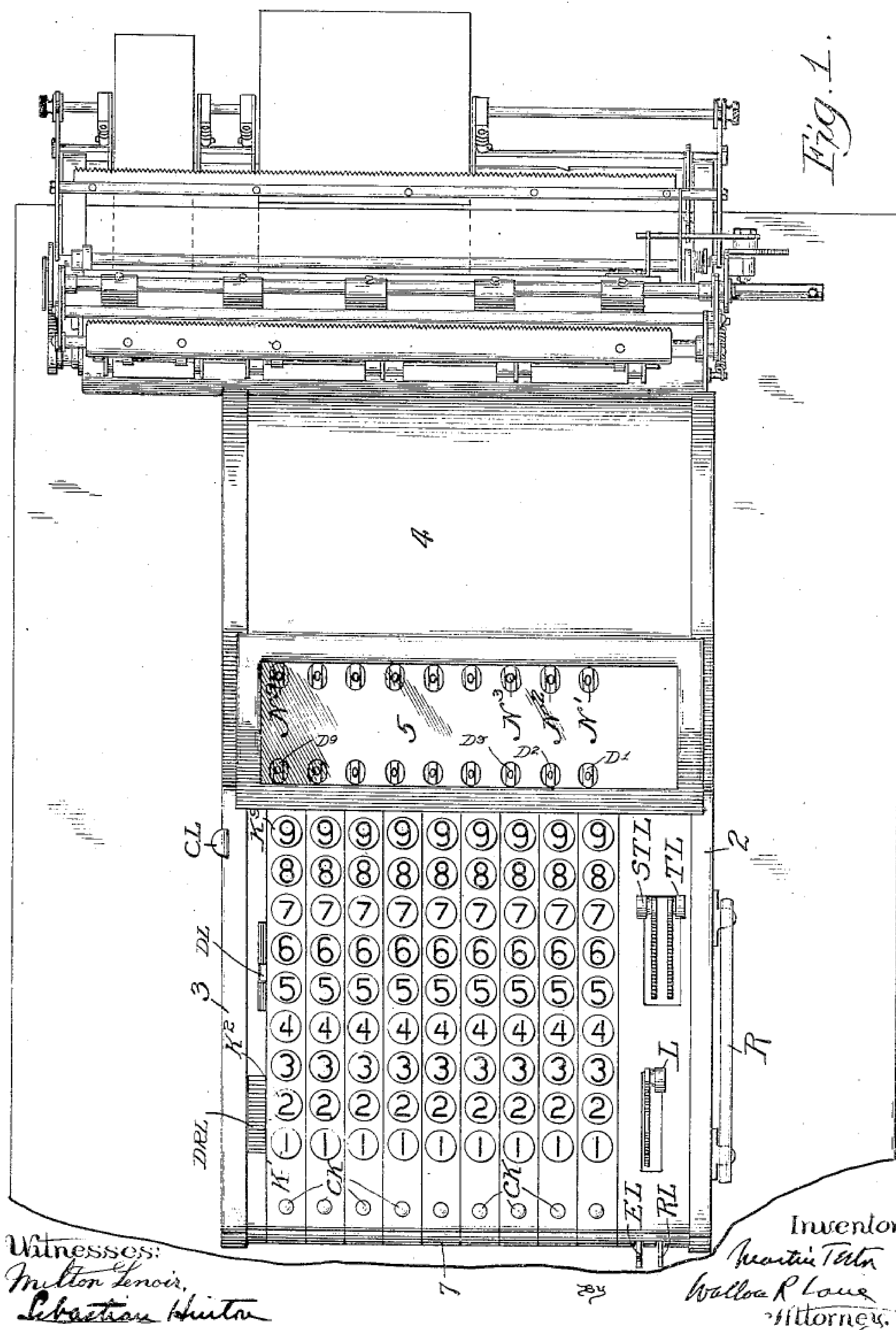
[*Official Gazette November 22, 1927.*]

NEXT ITEM

M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. Patented Mar. 15, 1921.

26 SHEETS—SHEET 1.



Witnesses:
Milton Lenoir,
Sebastian Hinton

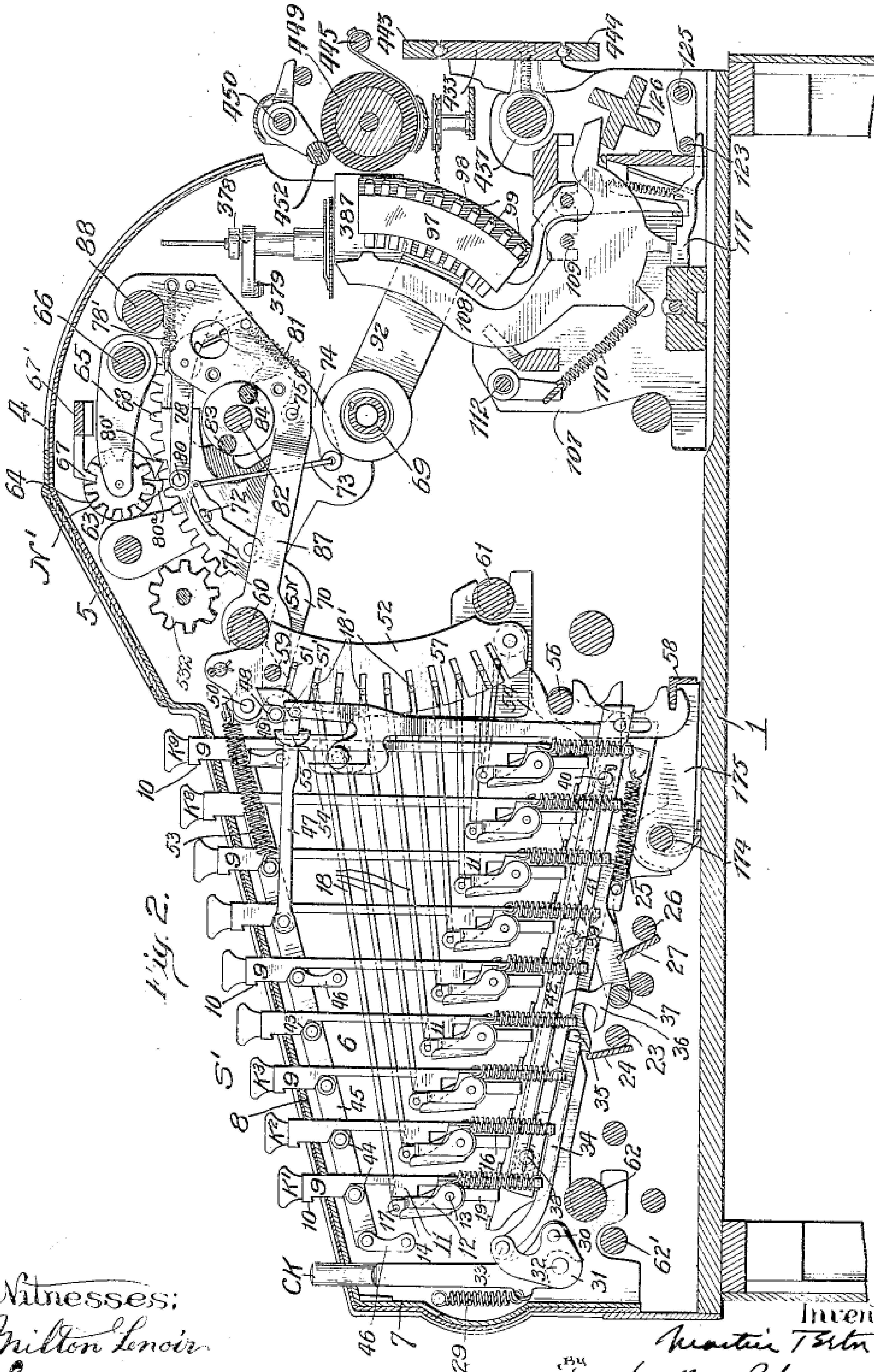
Inventor:
Martin Teetor
By Wallace R Lane
Attorneys.

1921 03 15 US1371526 p01.png

M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. Patented Mar. 15, 1921

26 SHEETS—SHEET 2.



Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
By Wallace R Lane
Attorney.

1921 03 15 US1371526 p02.png

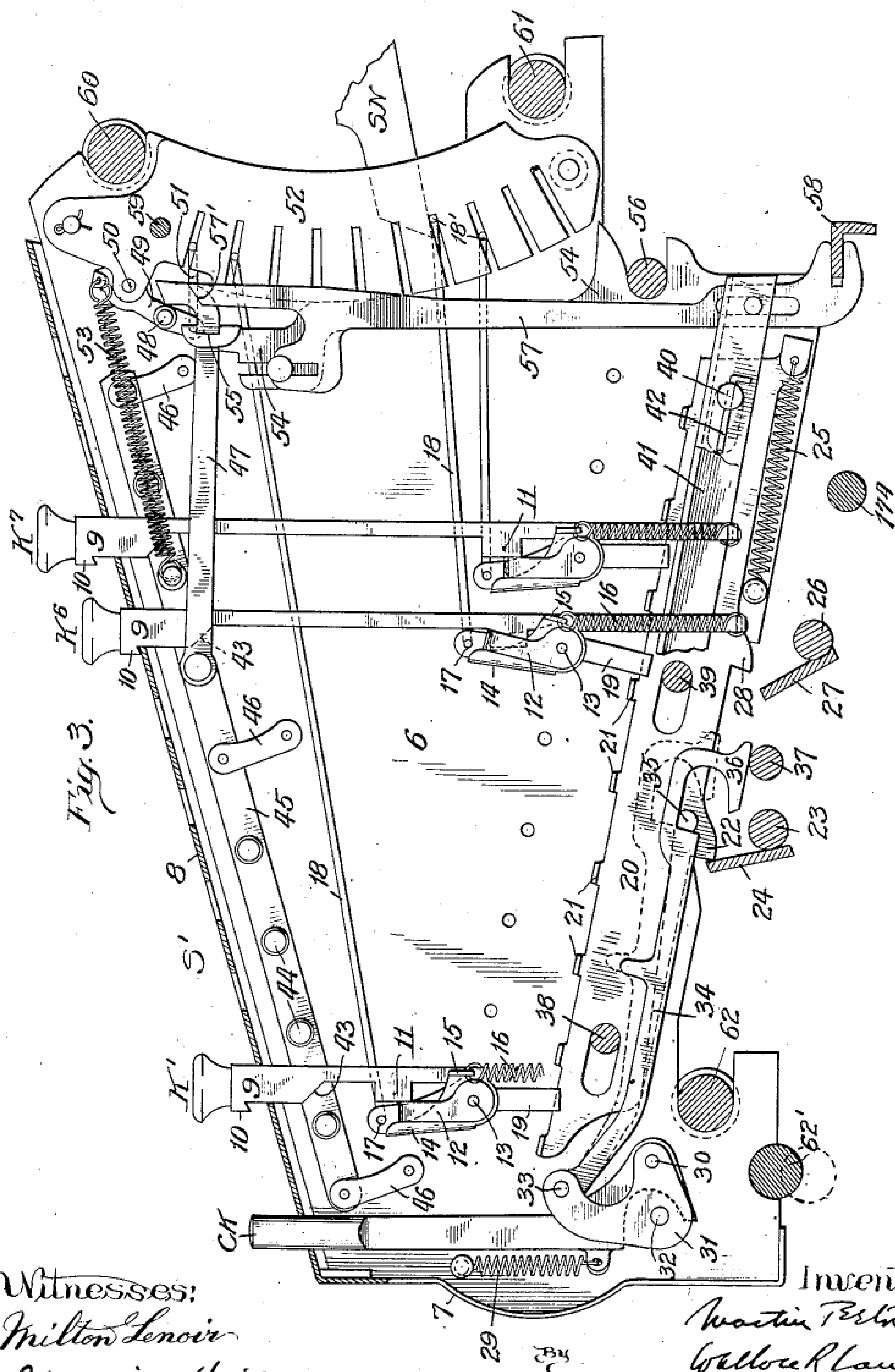
M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. **Patented Mar. 15, 1921.**

26 SHEETS—SHEET 3.



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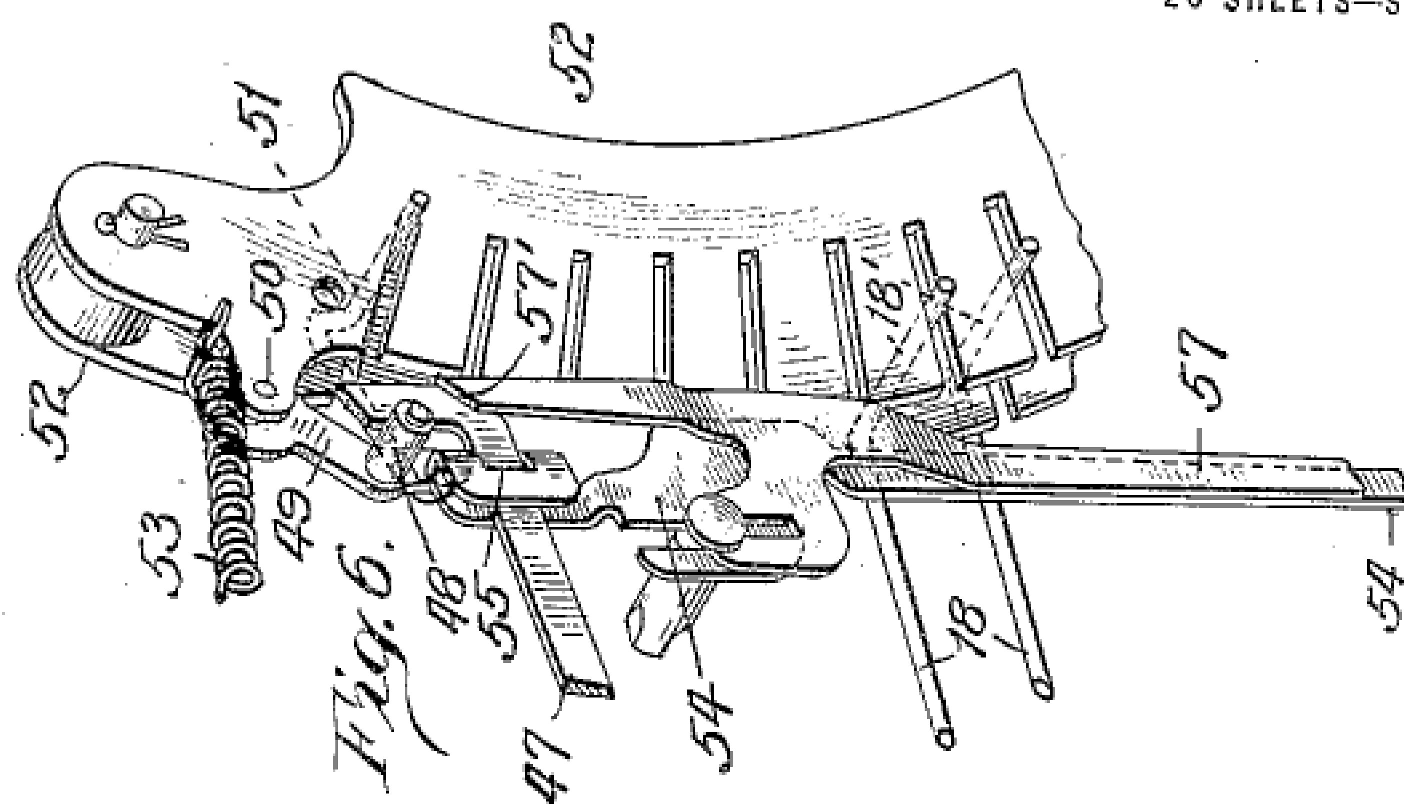
M. TEETOR.

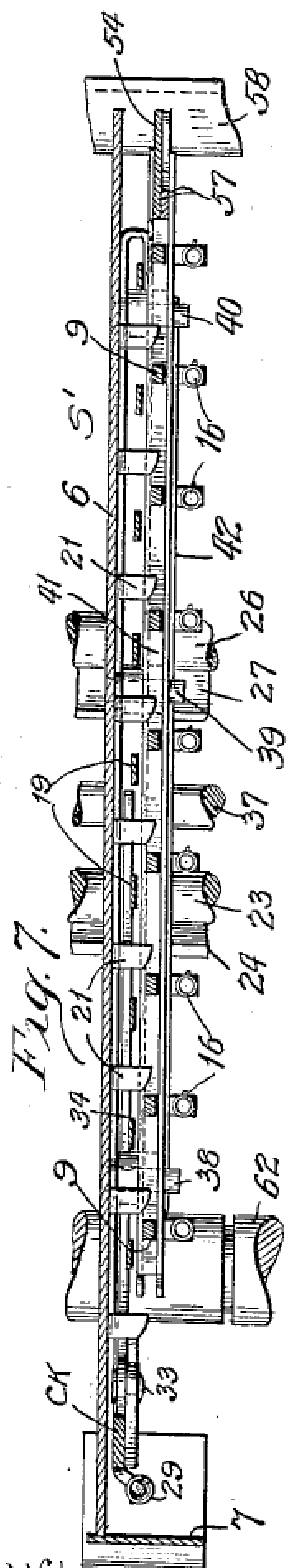
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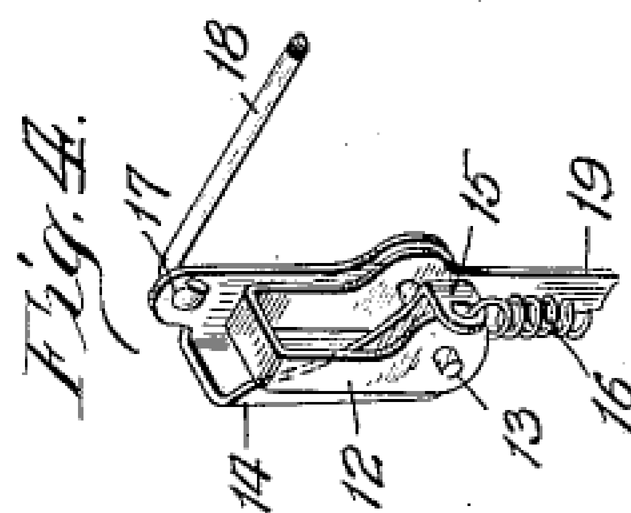
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

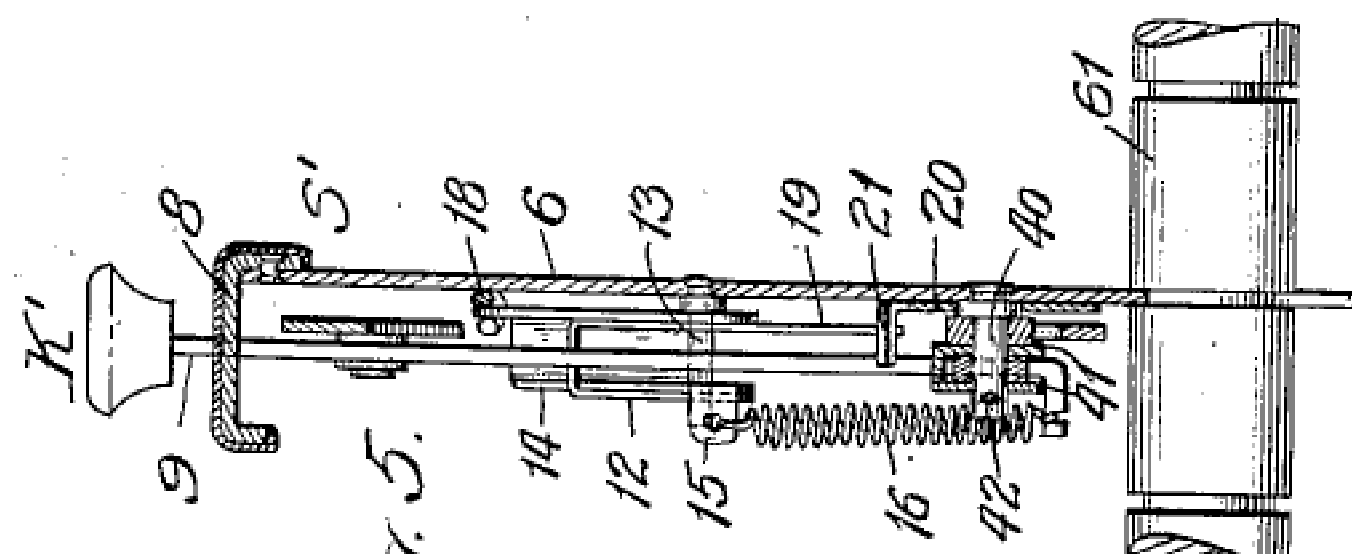
1,371,526. Patented Mar. 15, 1921.

26 SHEETS—SHEET 4.









Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
By Wallace R Lane
Attorneys.

1921 03 15 US1371526 p04.png

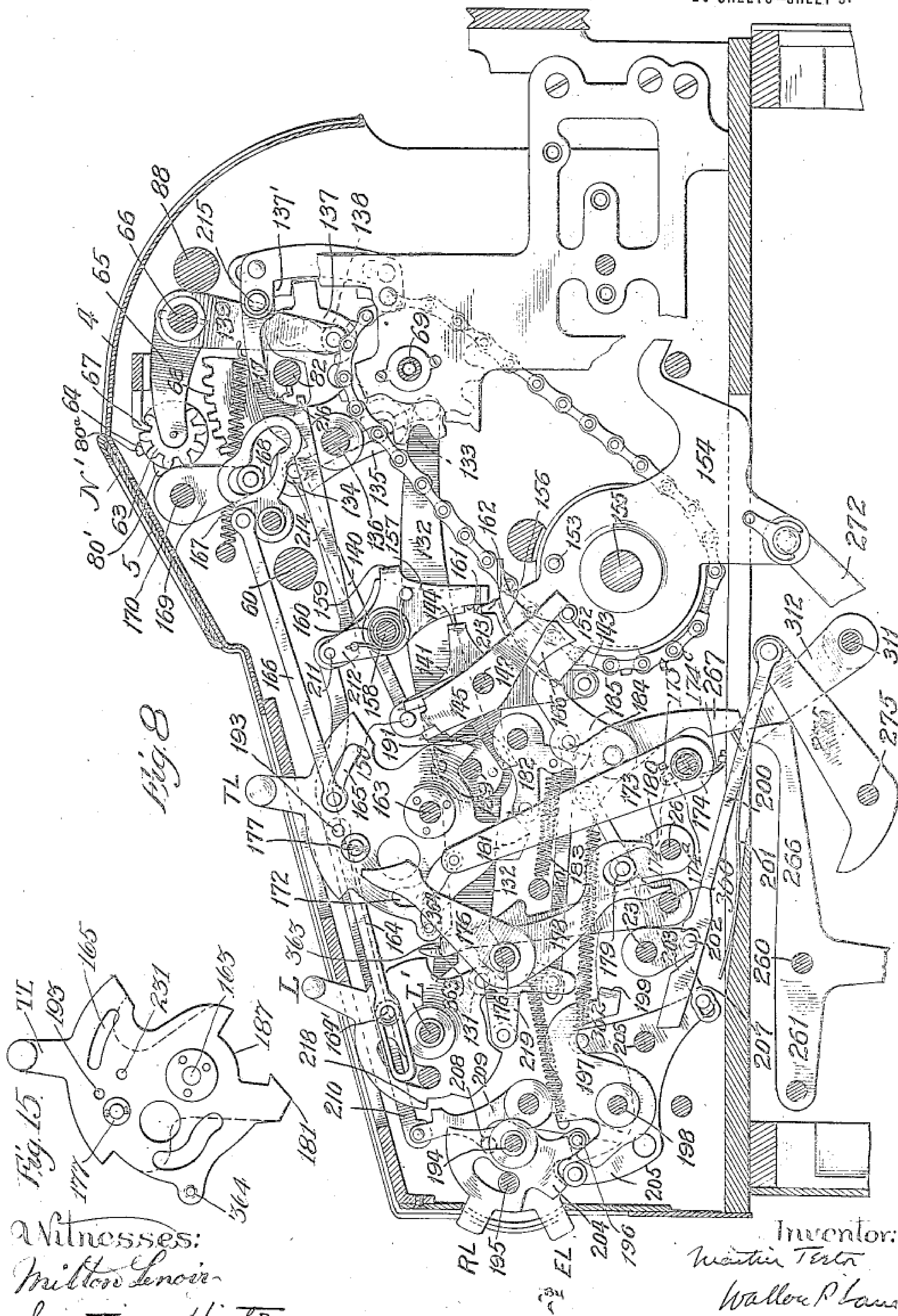
M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. Patented Mar. 15, 1921

26 SHEETS—SHEET 5.



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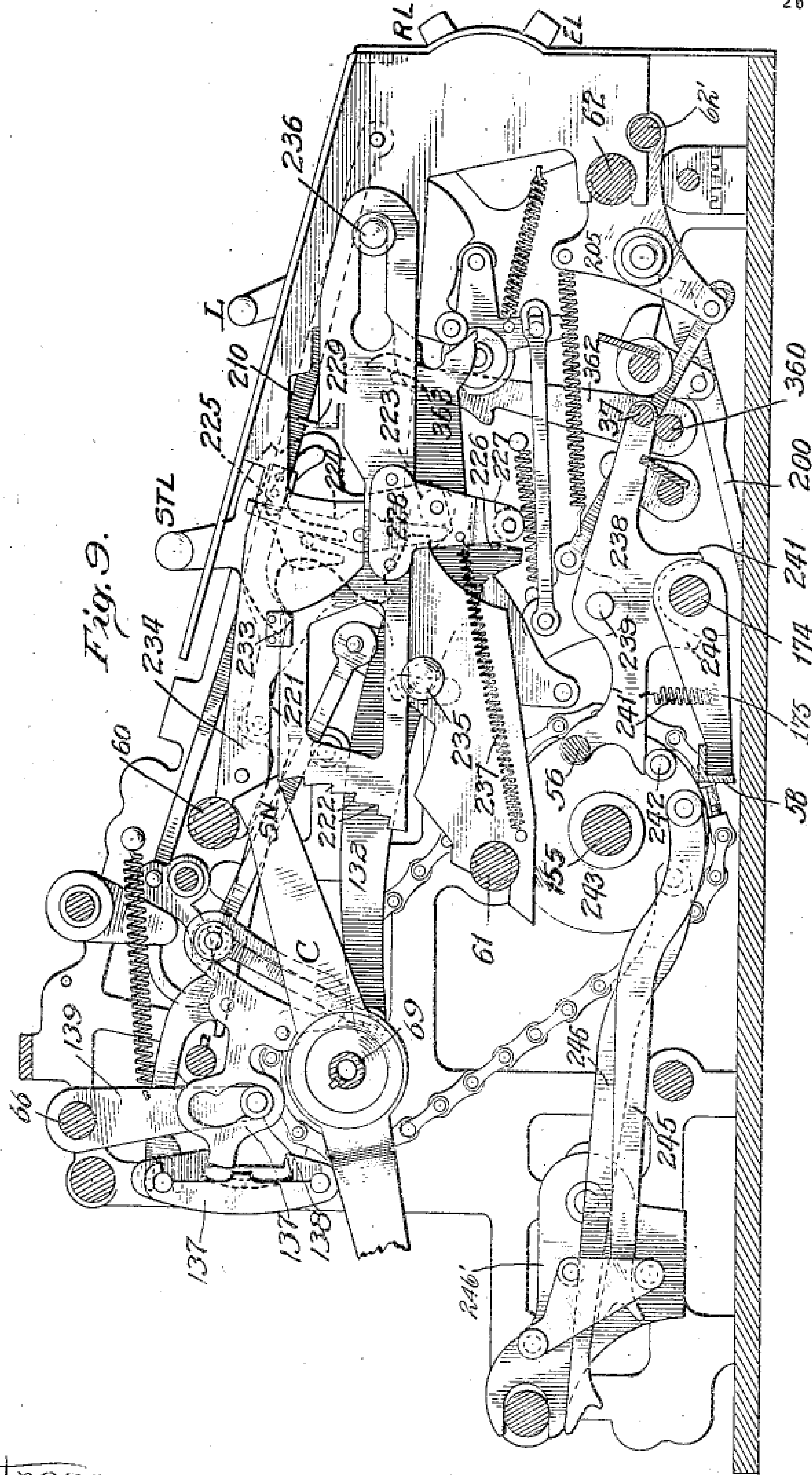
M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. **Patented Mar. 15, 1921.**

26 SHEETS—SHEET 6.



Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
Walton P. Lane
Attorney.

M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

Patented Mar. 15, 1921.

26 SHEETS—SHEET 7.

Fig. 10.

Fig. 14.

Witnesses:

Milton Lenoir

Sebastian Hinton

Inventor:

Martin Teetor

Wallace R Lane

Attorney.

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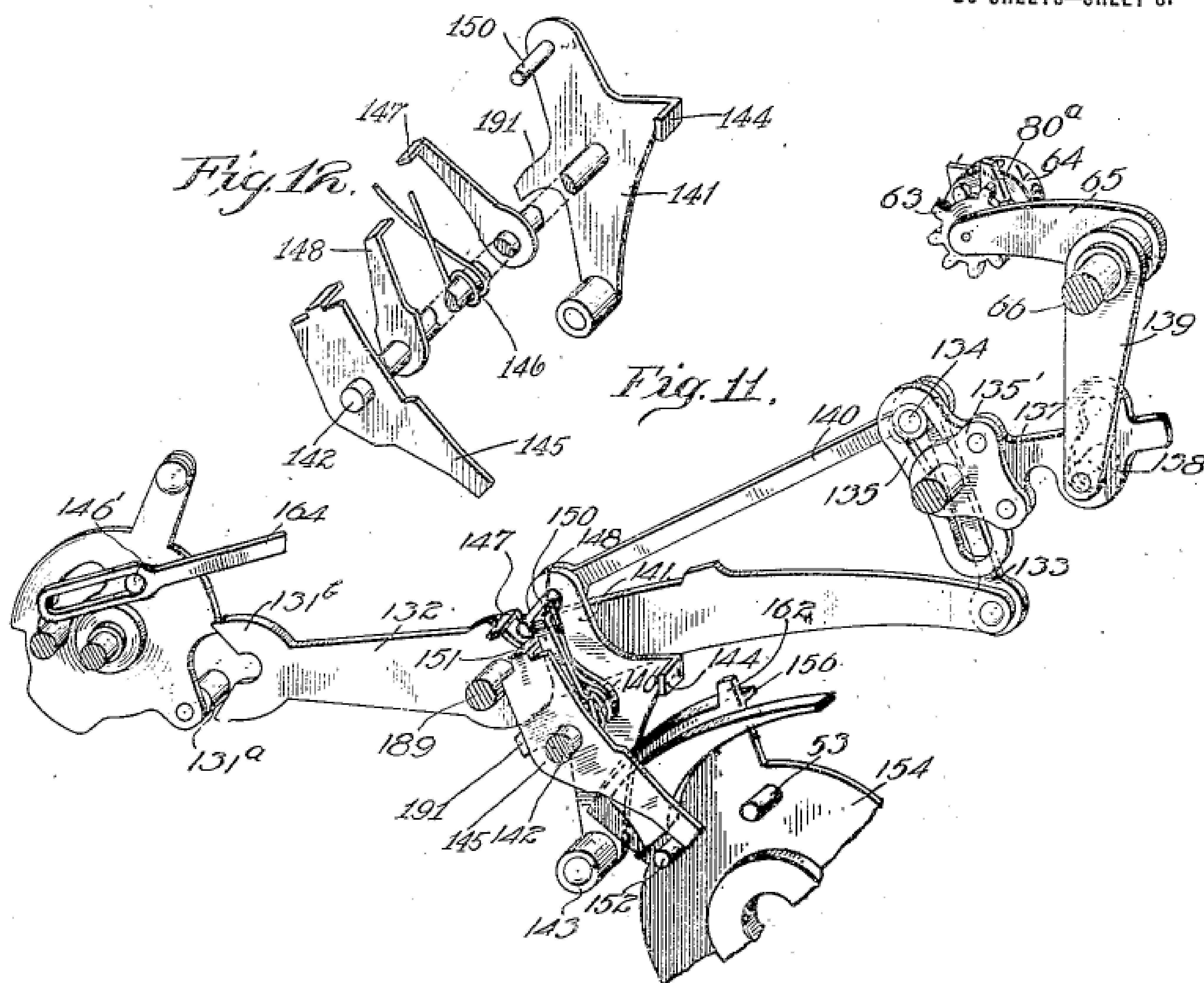
M. TEETOR.

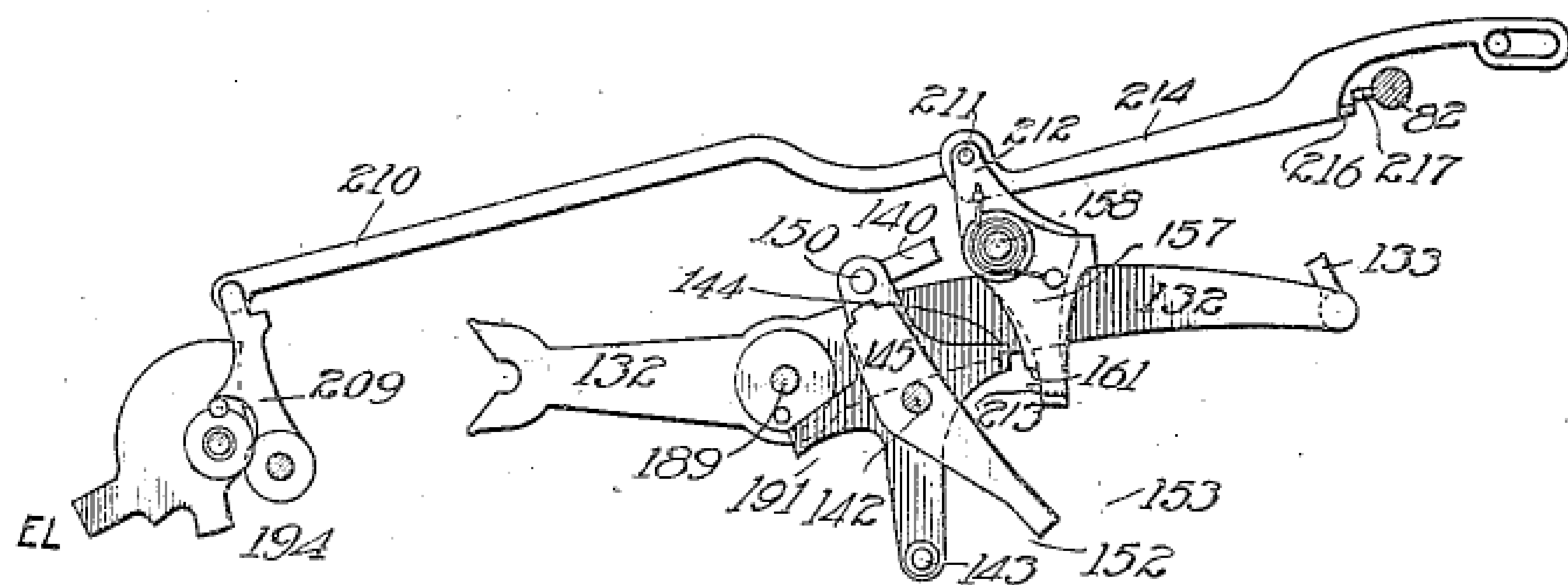
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26 SHEETS—SHEET 8.





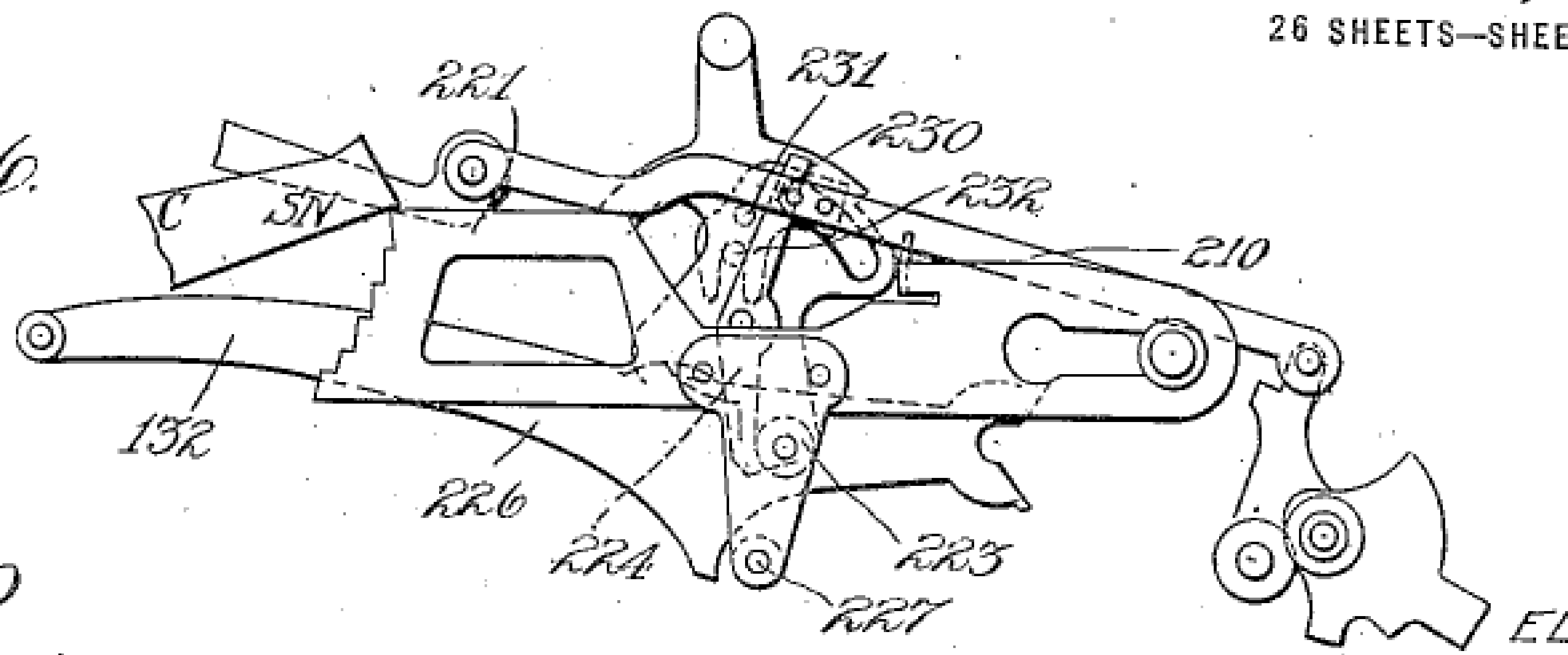
Witnesses:
Milton Lenoir
Sebastian Hinton

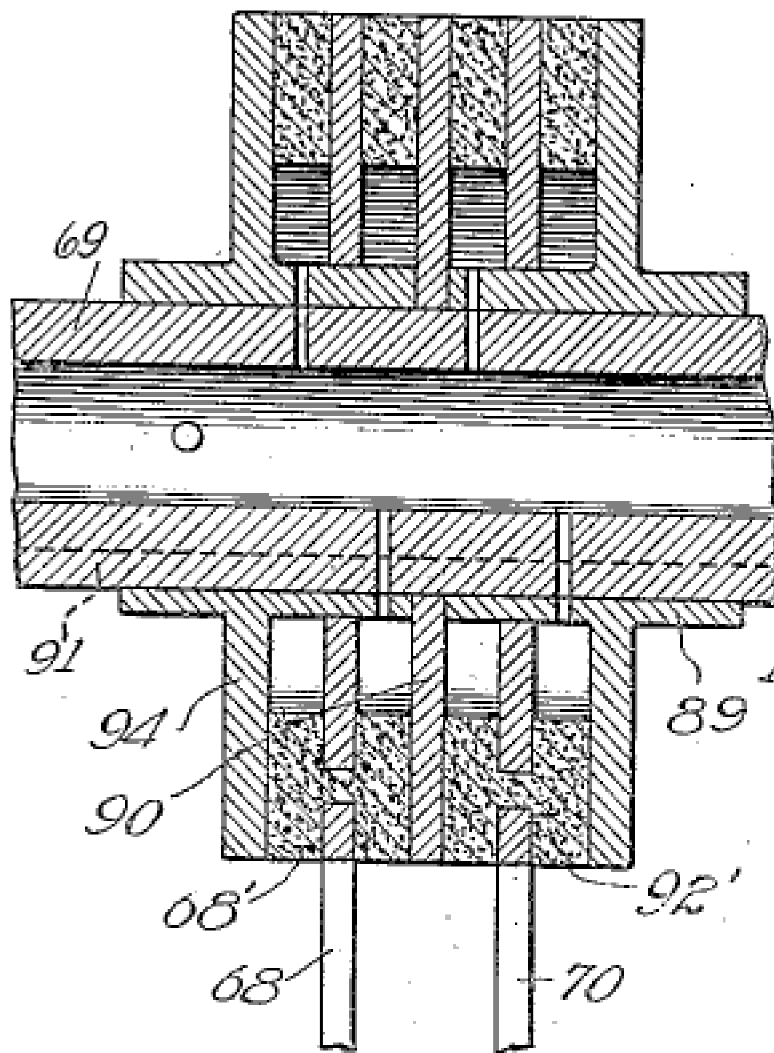
Inventor:
Martin Teetor
Wallace R Lane
Attorney

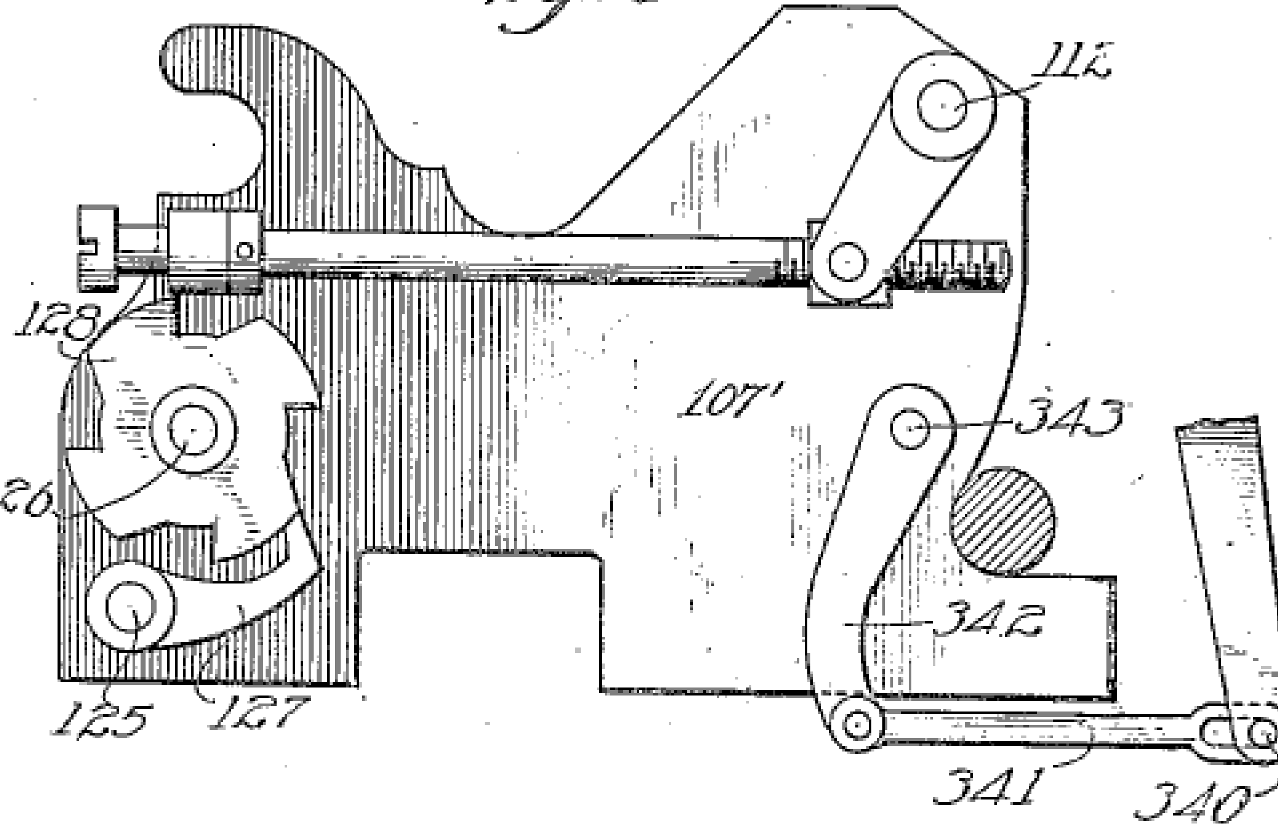
M. TEETOR.
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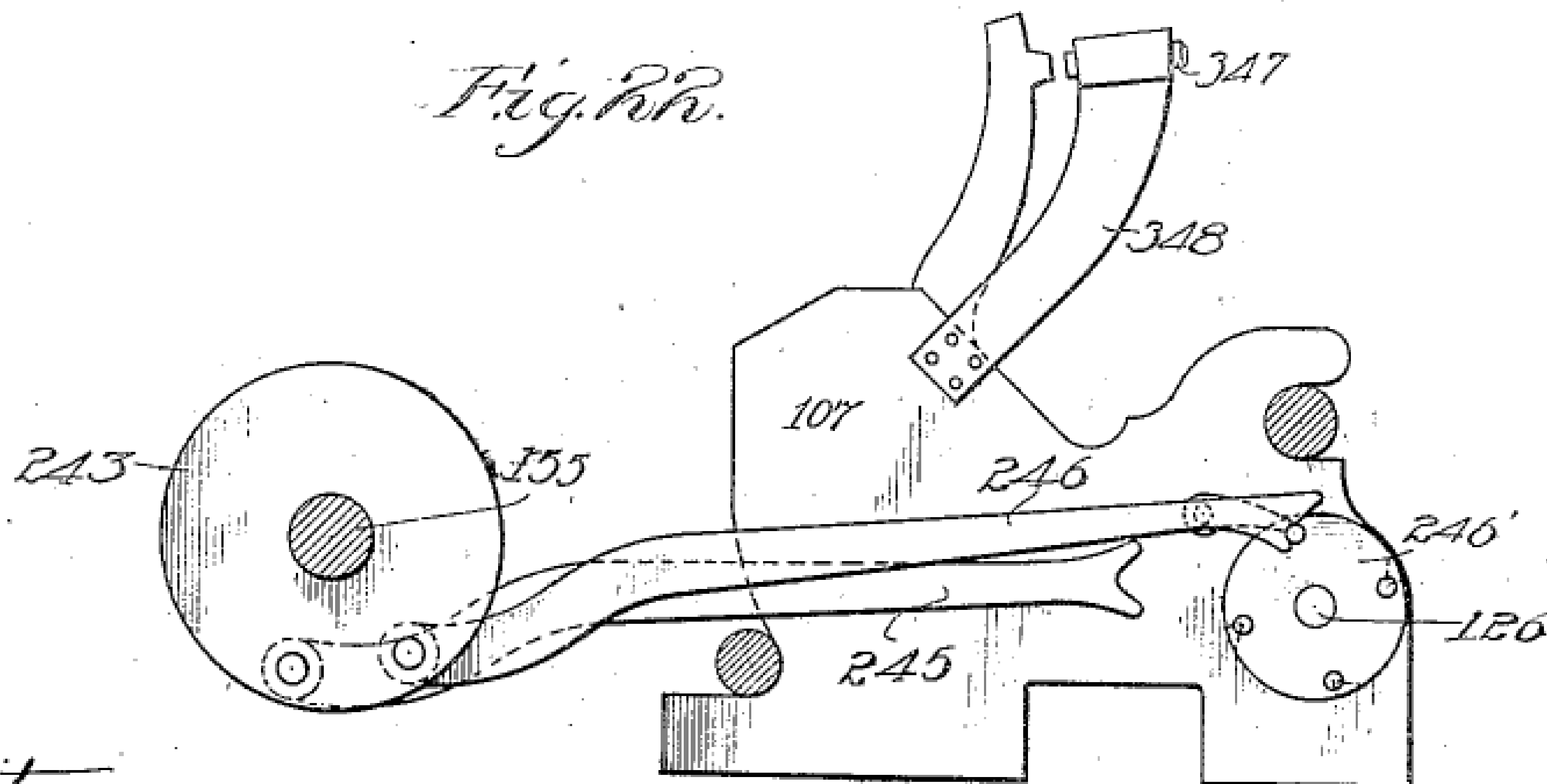
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26 SHEETS—SHEET 9.









Witnesses:
W. M. Haenel
Sebastian Hinton

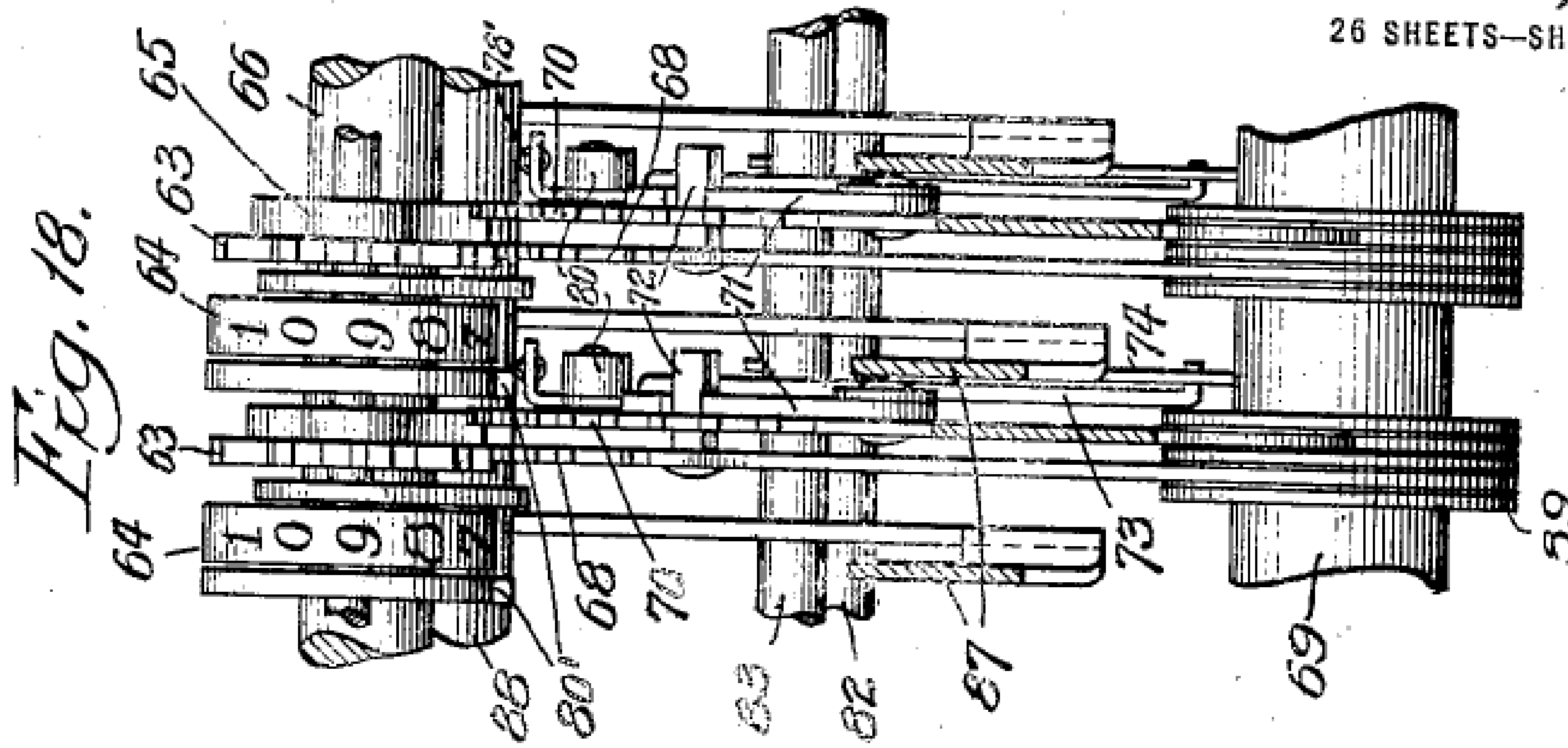
Inventor
Martin Teetor
Wallace R. Lane
Attorney

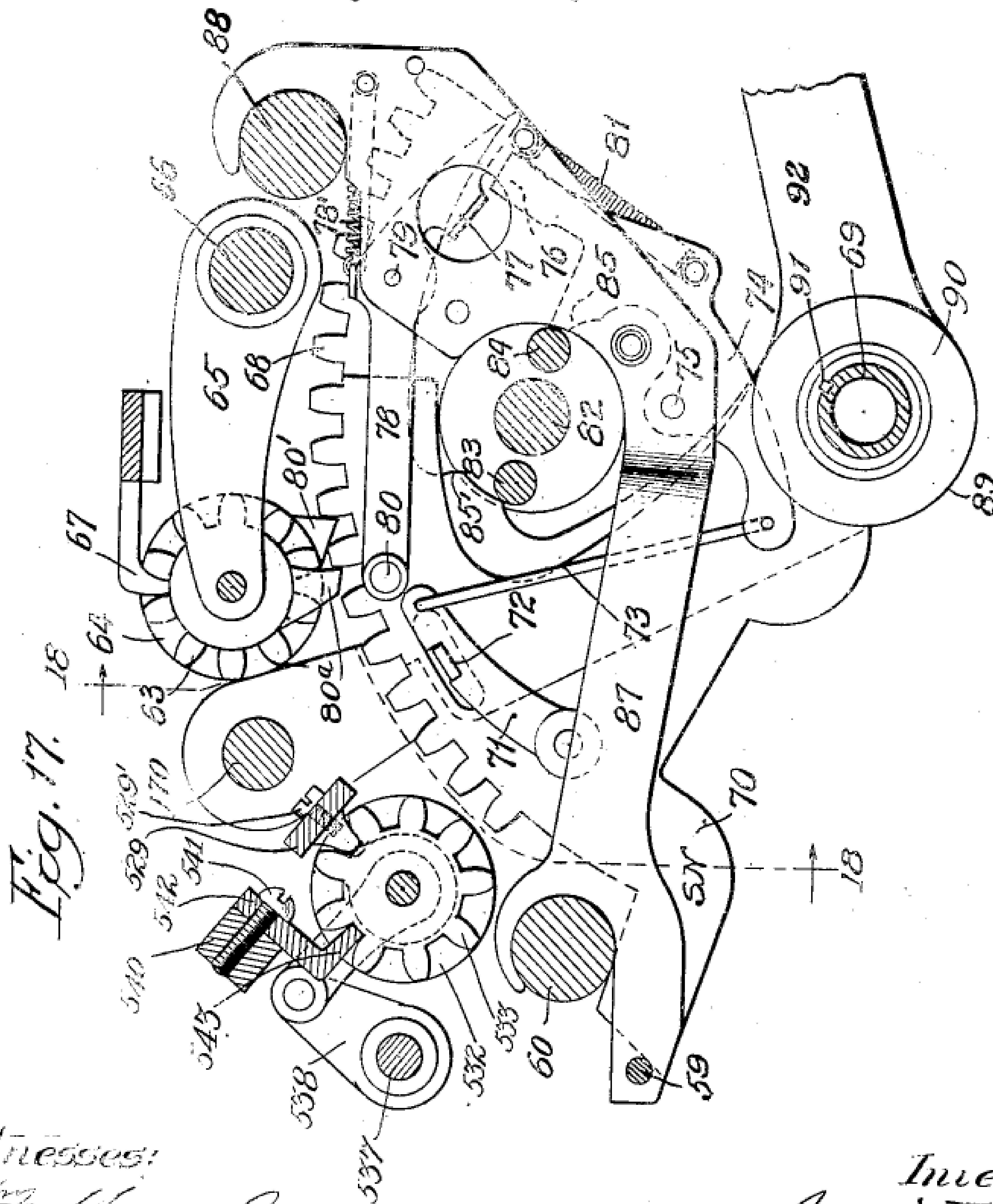
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M. TEETOR.
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26 SHEETS—SHEET 10.





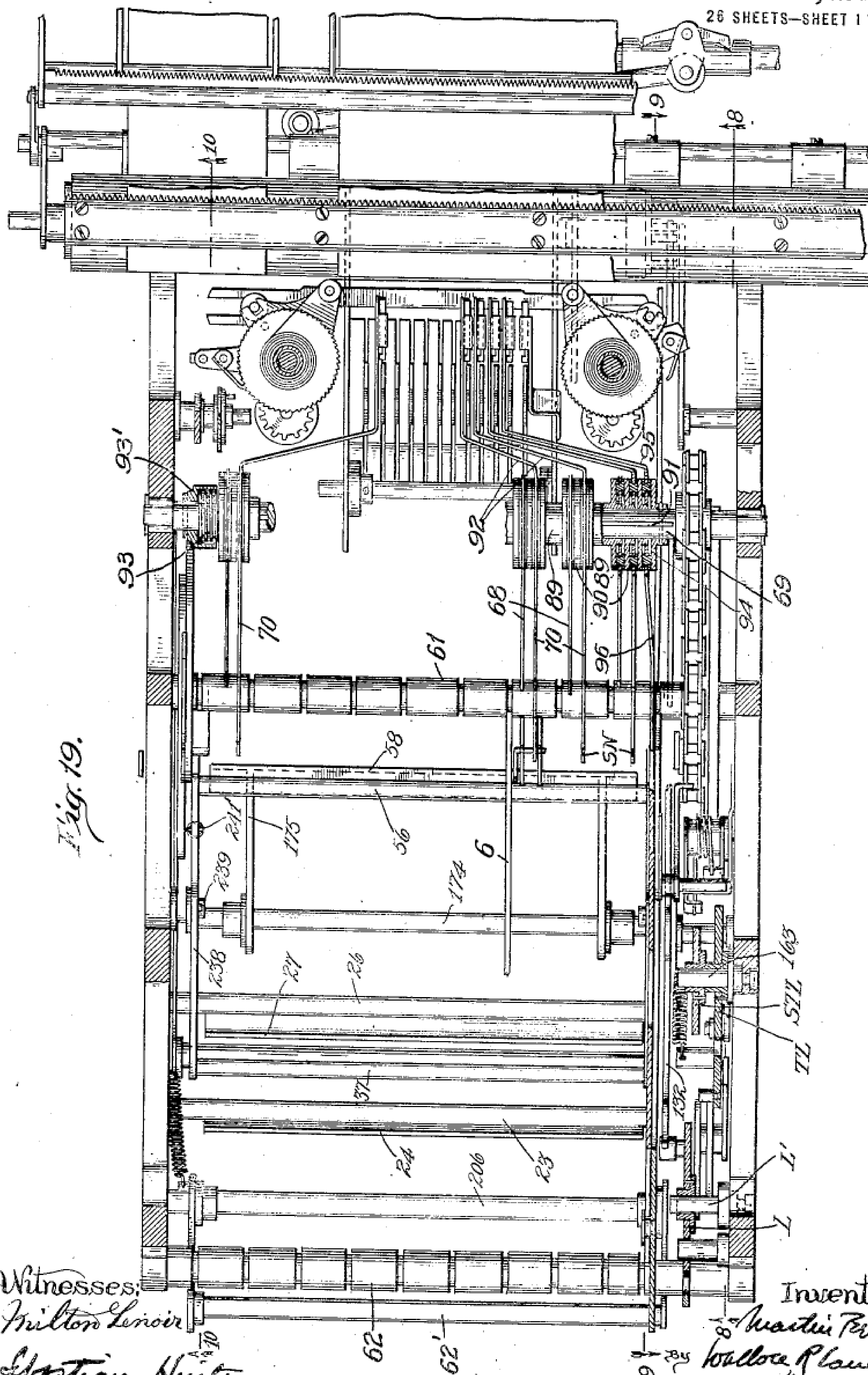
Witnesses:
J. M. Haenel
Sebastian Hurter

Inventor
Martin Teetor
Wallace R. Lane
Attorney

M. TEETOR.
CALCULATING MACHINE.
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26 SHEETS—SHEET 11.



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M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

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26 SHEETS—SHEET 12.

Witnesses:
John Enders
Sebastian Hinton

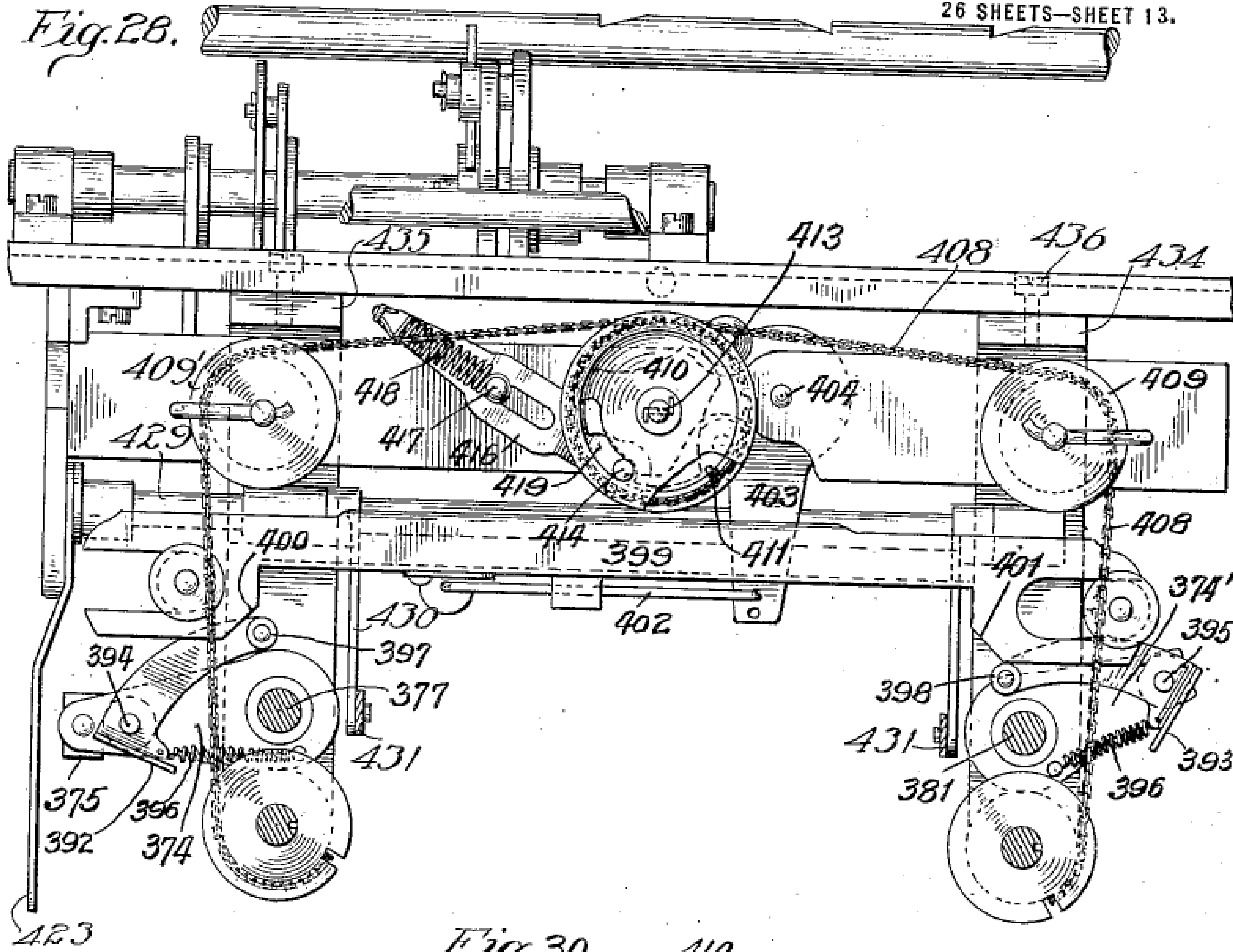
Inventor:
Martin Teetor
by Wallace R Lane Atty.

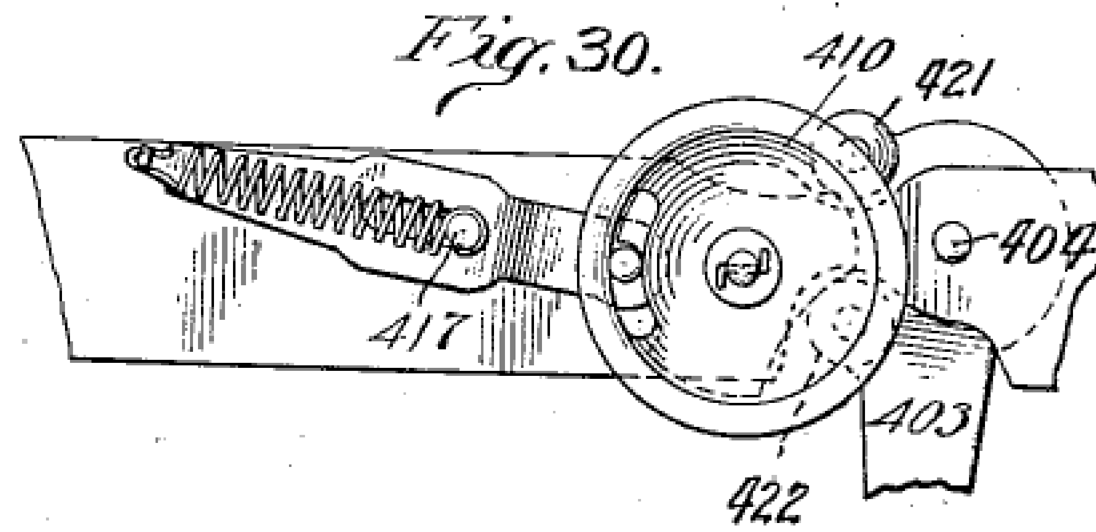
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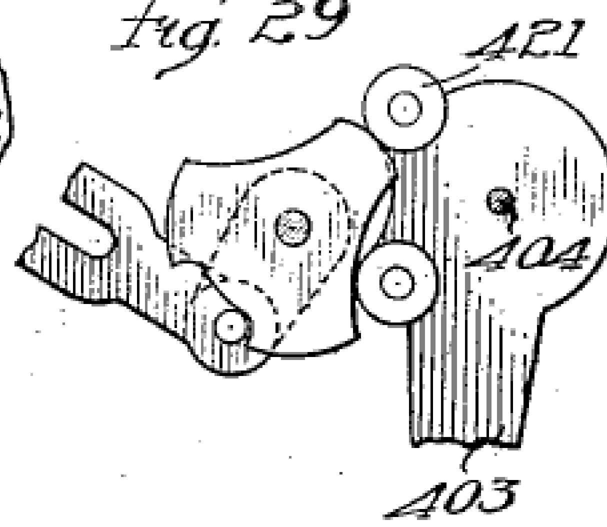
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CALCULATING MACHINE.
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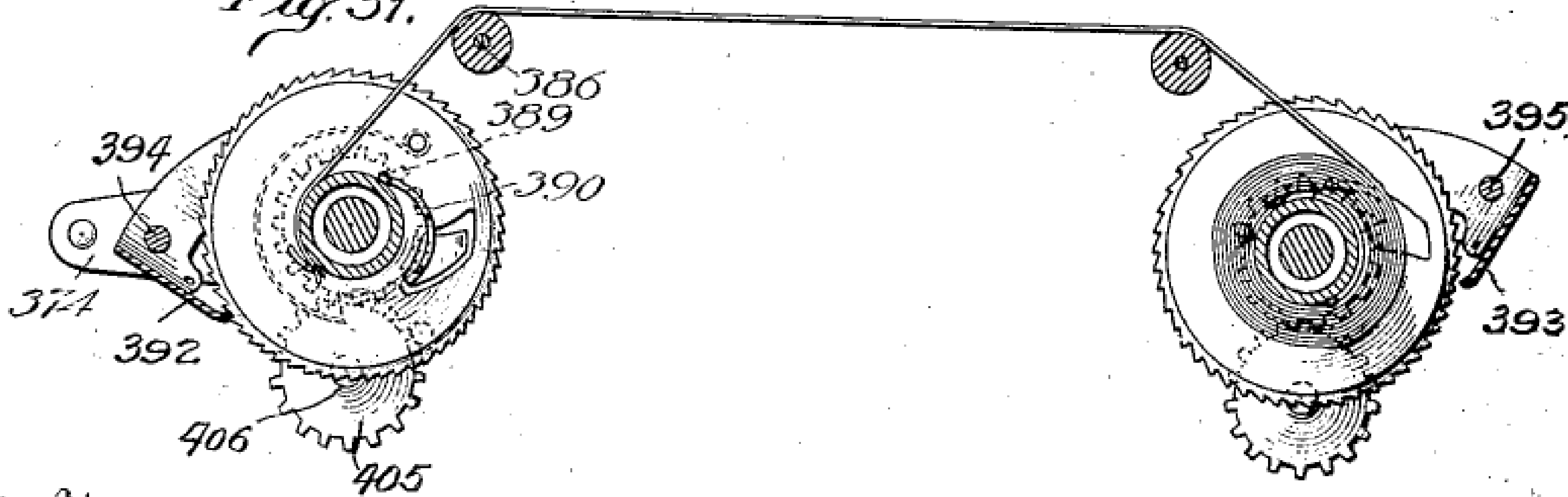
1,371,526. **Patented Mar. 15, 1921.**

26 SHEETS—SHEET 13.









Witnesses:
Milton Lenoir.
Sebastian Hinton.

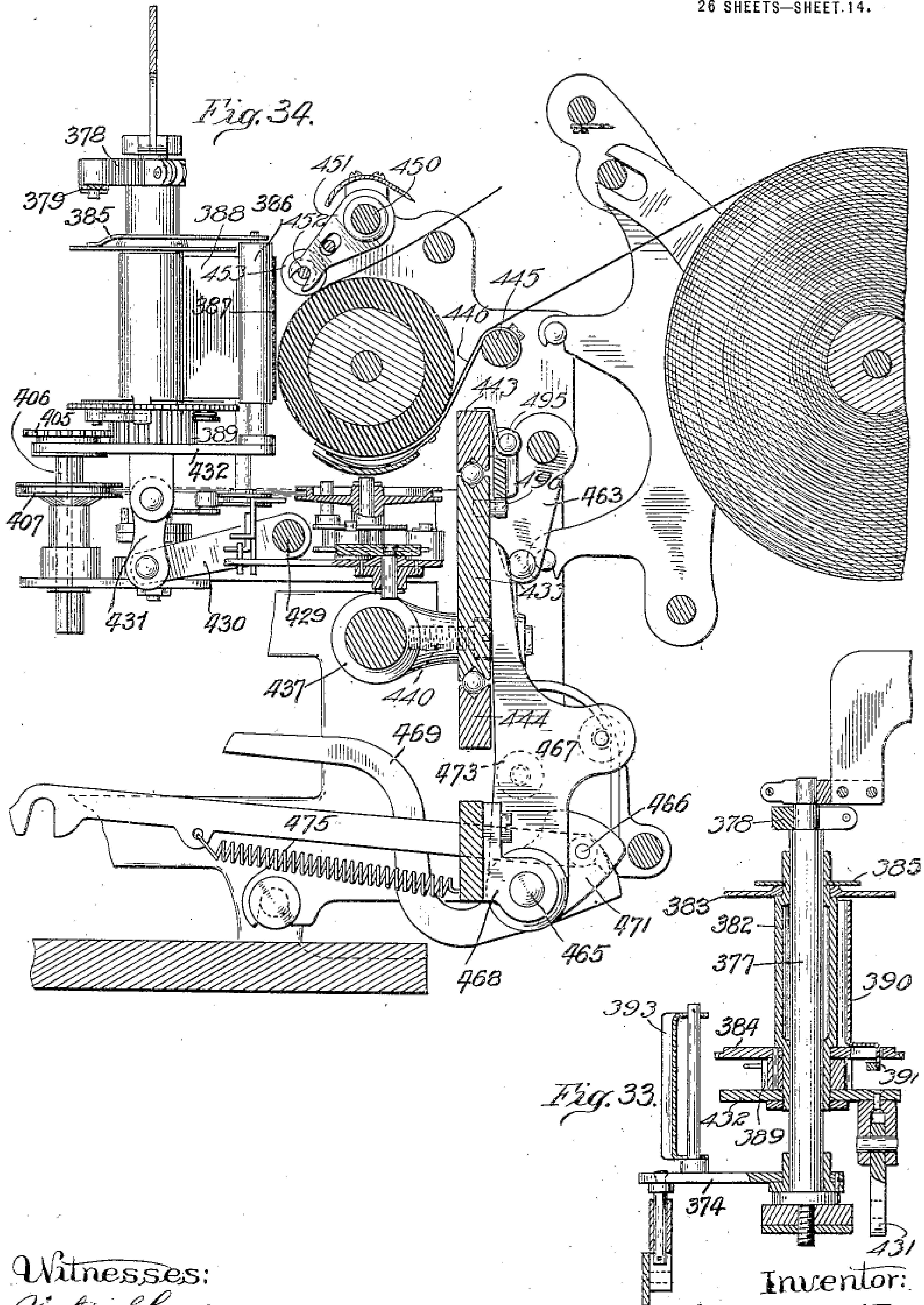
Inventor:
Martin Teetor
Wallace R. Lane
Attorney.

1921 03 15 US1371526 p13.png

M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. Patented Mar. 15, 1921.

26 SHEETS—SHEET 14.



Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
By Wallace R Lane
Attorney

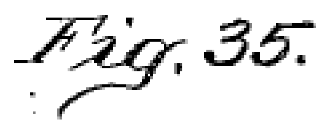
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26 SHEETS—SHEET 15.





Witnesses:
Milton Lenoir
Sebastian Hinton

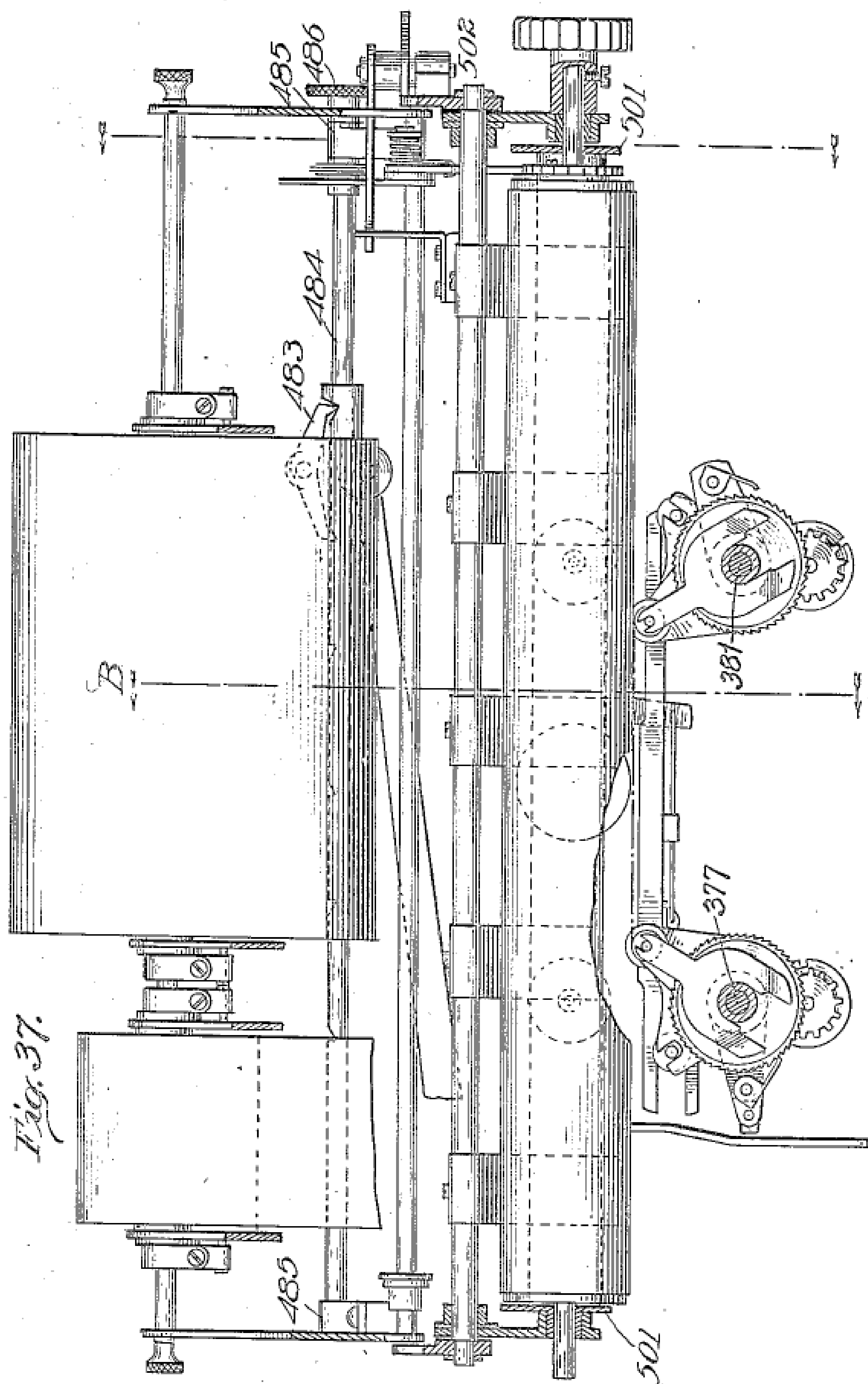
Inventor:
Martin Teetor
By Wallace R Lane
Attorney.

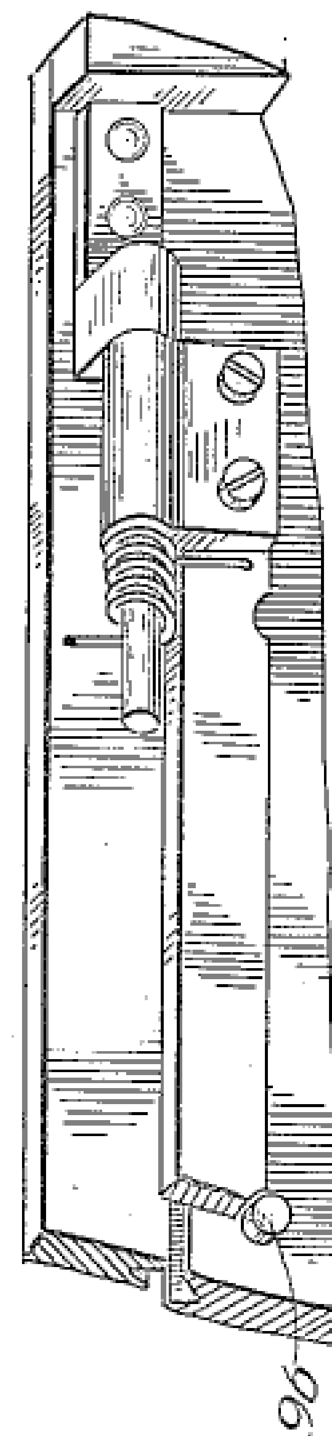
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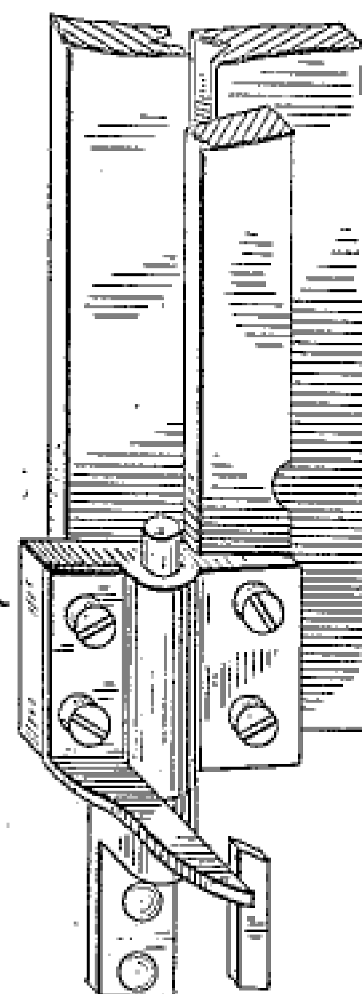
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26 SHEETS—SHEET 16.







Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
By Wallace Lane
Attorney.

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M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

Patented Mar. 15, 1921.
26 SHEETS—SHEET 17.

Fig. 41.

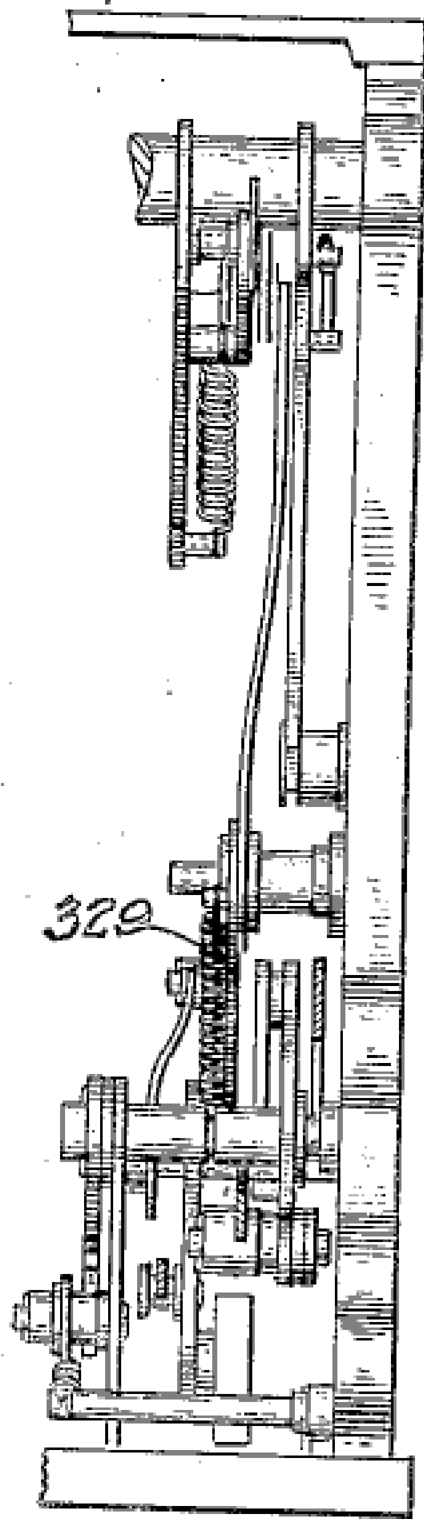


Fig. 40.

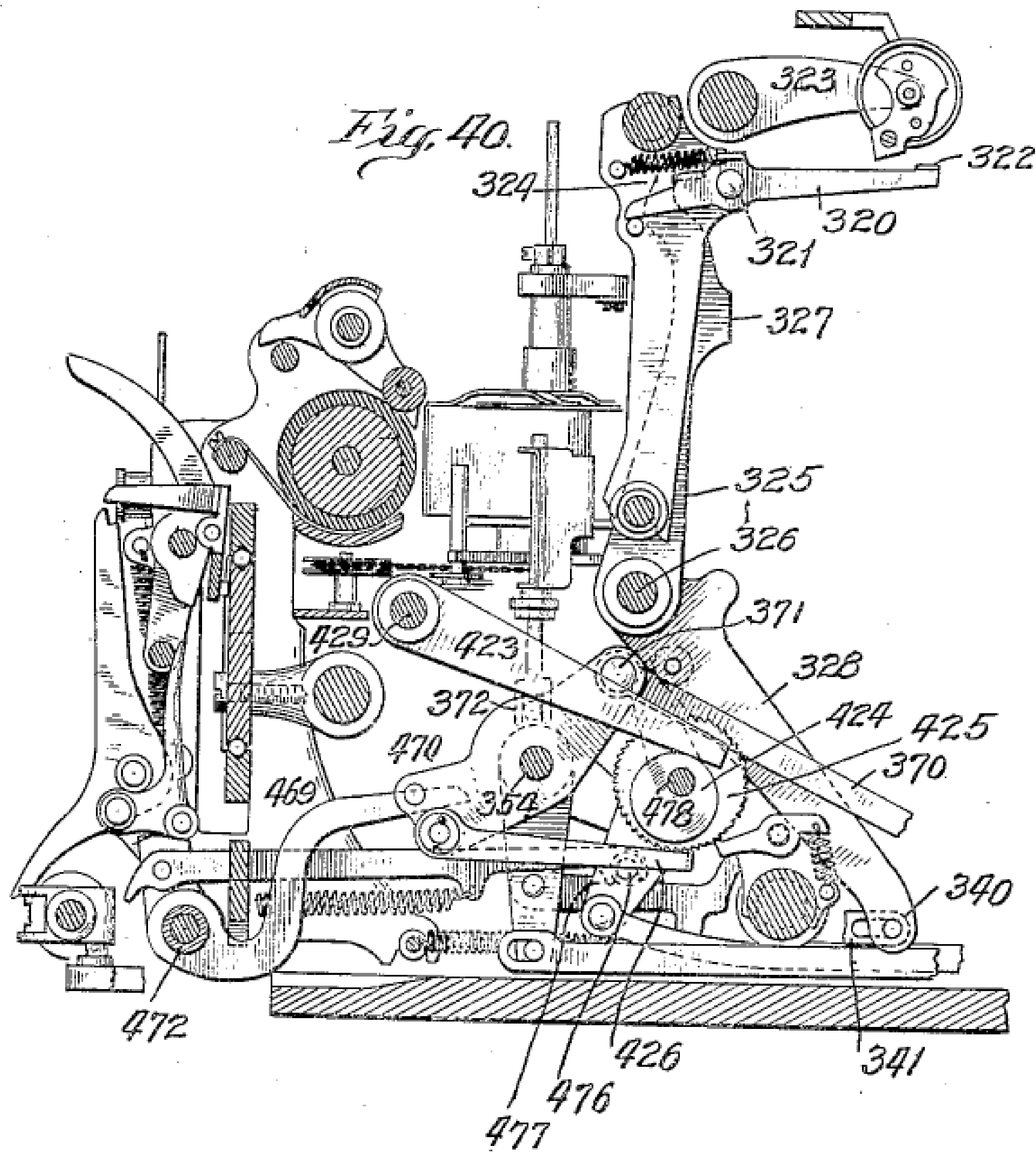
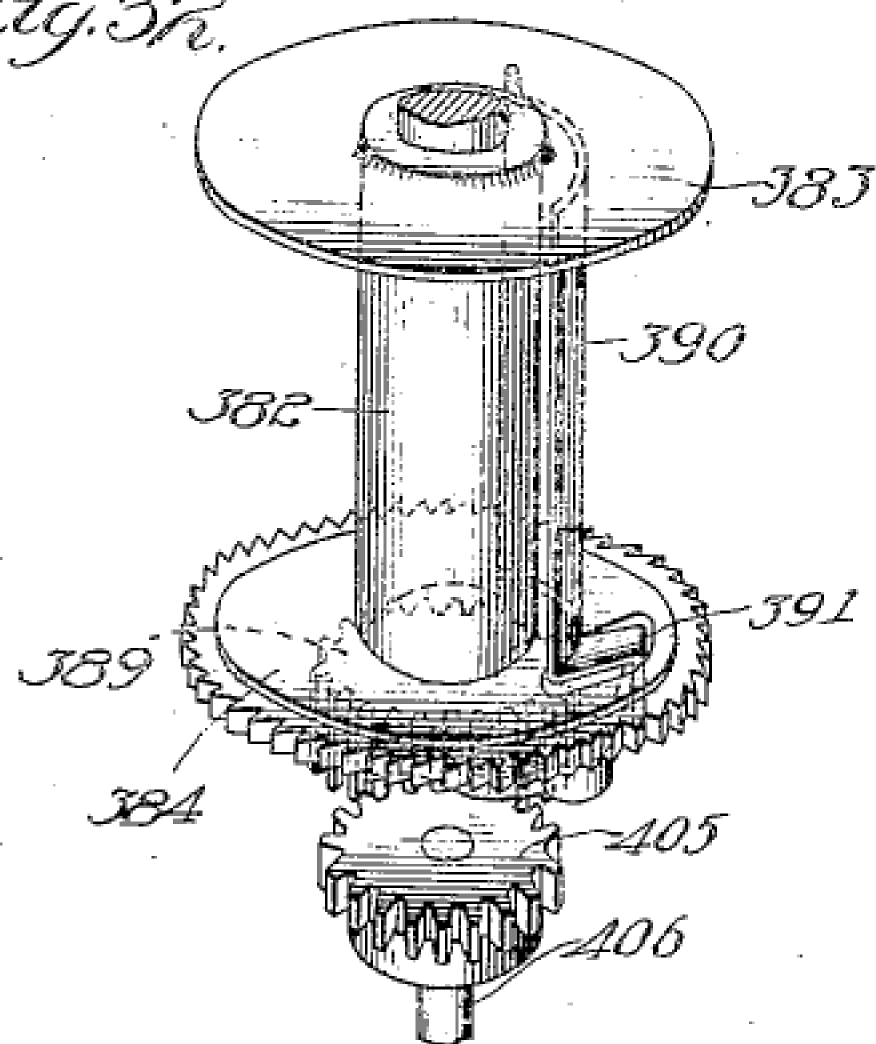


Fig. 37.



Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
Walter P. Lane
Attorneys.

M. TEETOR.

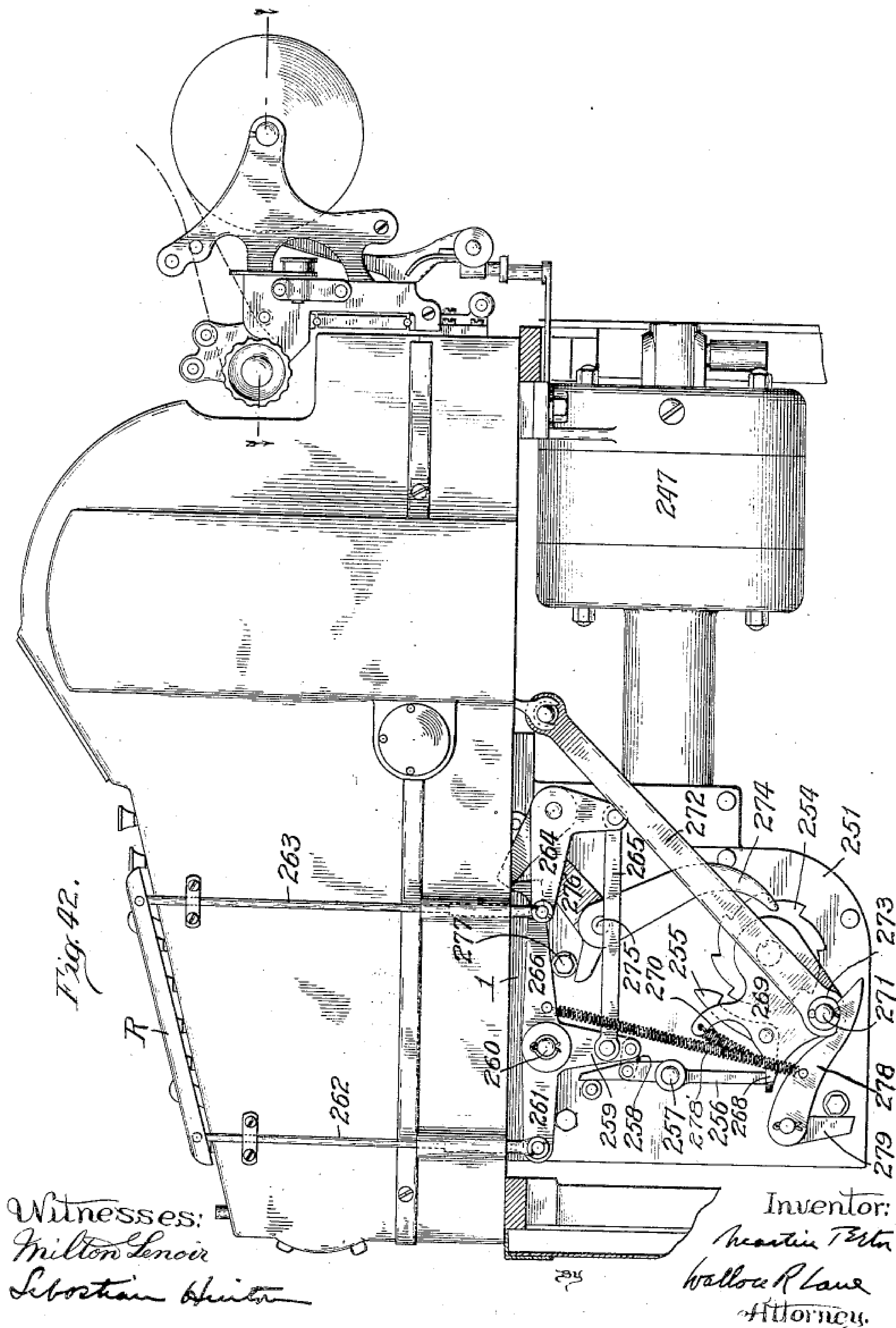
CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

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Patented Mar. 15, 1921.

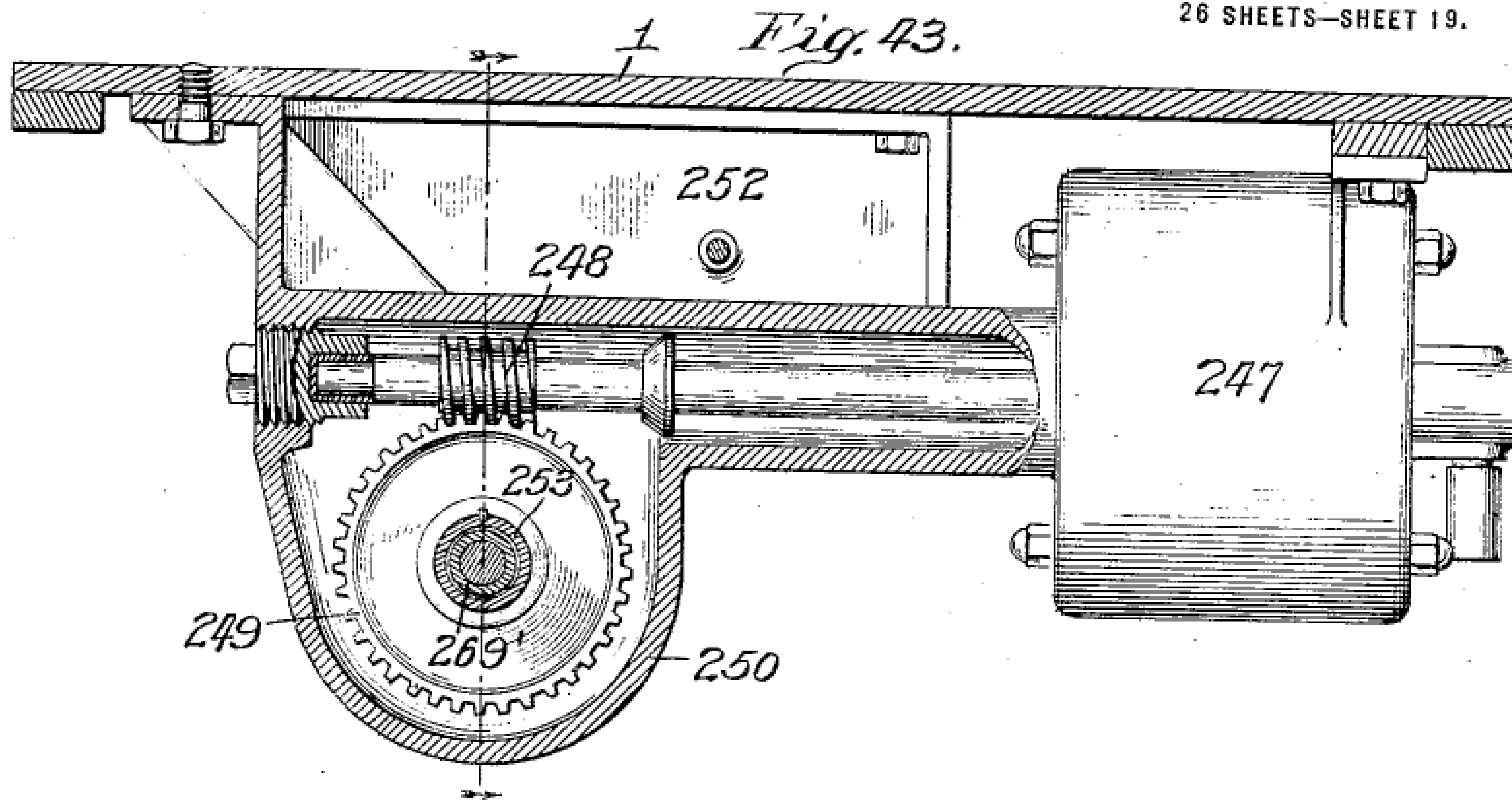
26 SHEETS—SHEET 18.

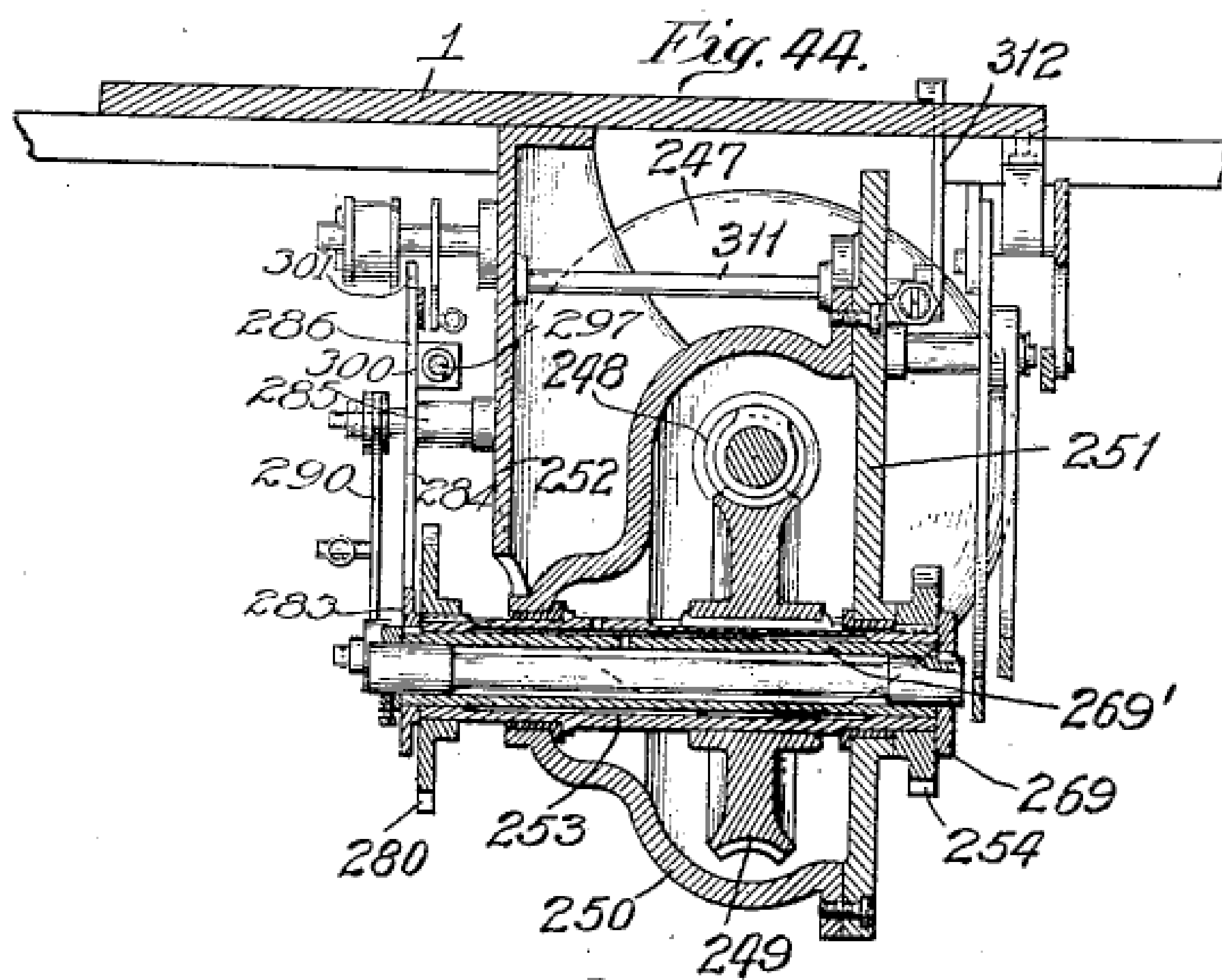


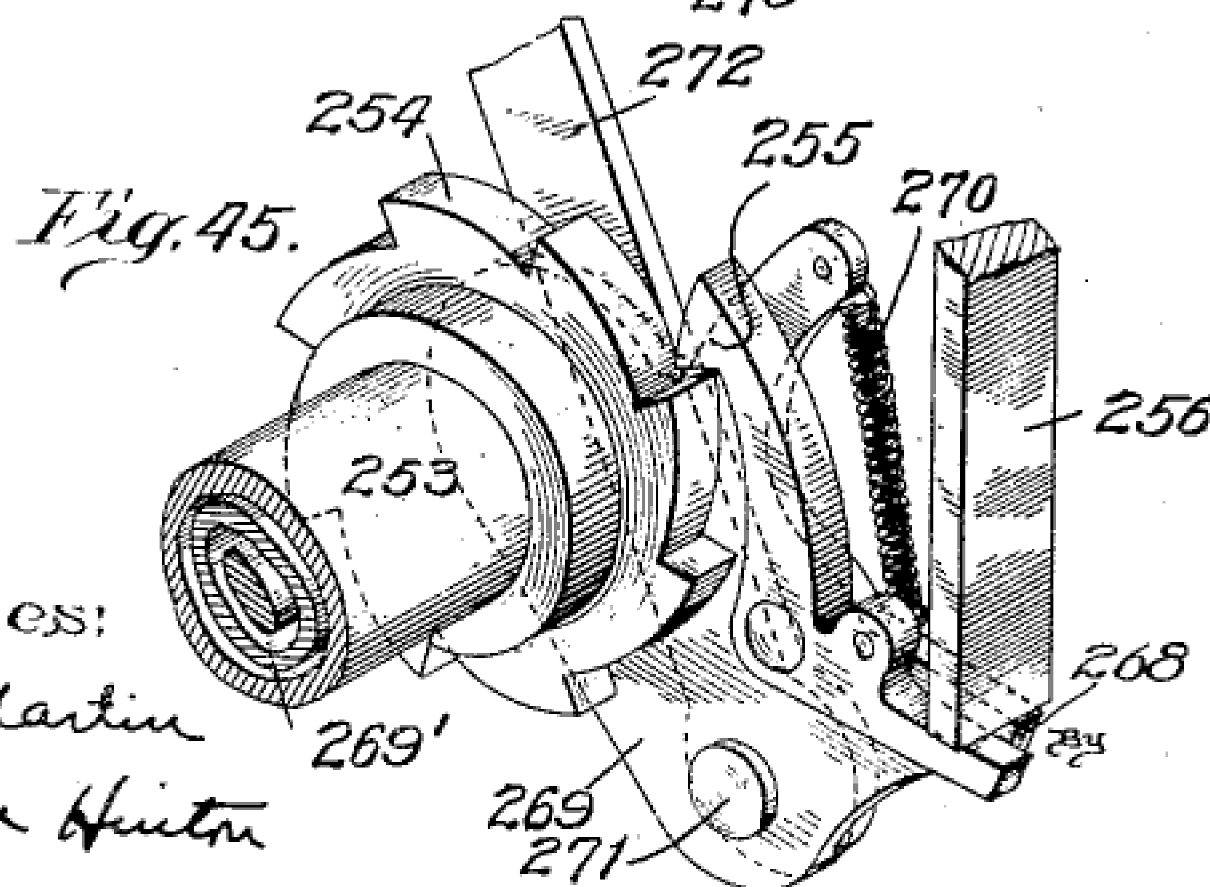
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APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

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26 SHEETS—SHEET 19.







Witnesses:
M. E. Martin
Sebastian Hinton

Inventor:
Martin Teetor
By Wallace R. Lane
Attorney.

M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. **Patented Mar. 15, 1921.**

26 SHEETS—SHEET 20.

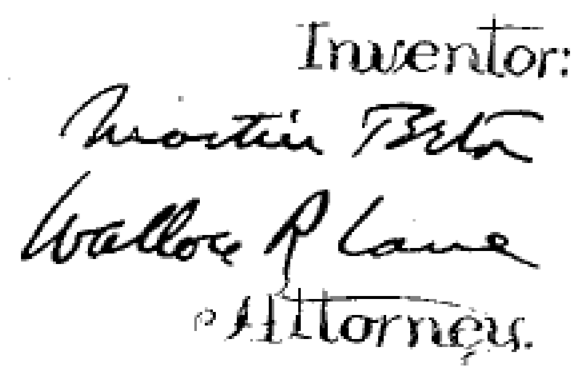
Fig. 46.

Witnesses:

Milton Lenoir

Sebastian Hinton

Inventor:



Martin Teetor

Wallace R Lane

Attorney.

M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

Patented Mar. 15, 1921.

26 SHEETS—SHEET 21.



Fig. 47.

Witnesses:

Milton Lenoir

Sebastian Hinton

Inventor:

Martin Teetor

By Wallace R Lane

Attorney.

M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

Patented Mar. 15, 1921.

26 SHEETS—SHEET 22.

Fig. 48.

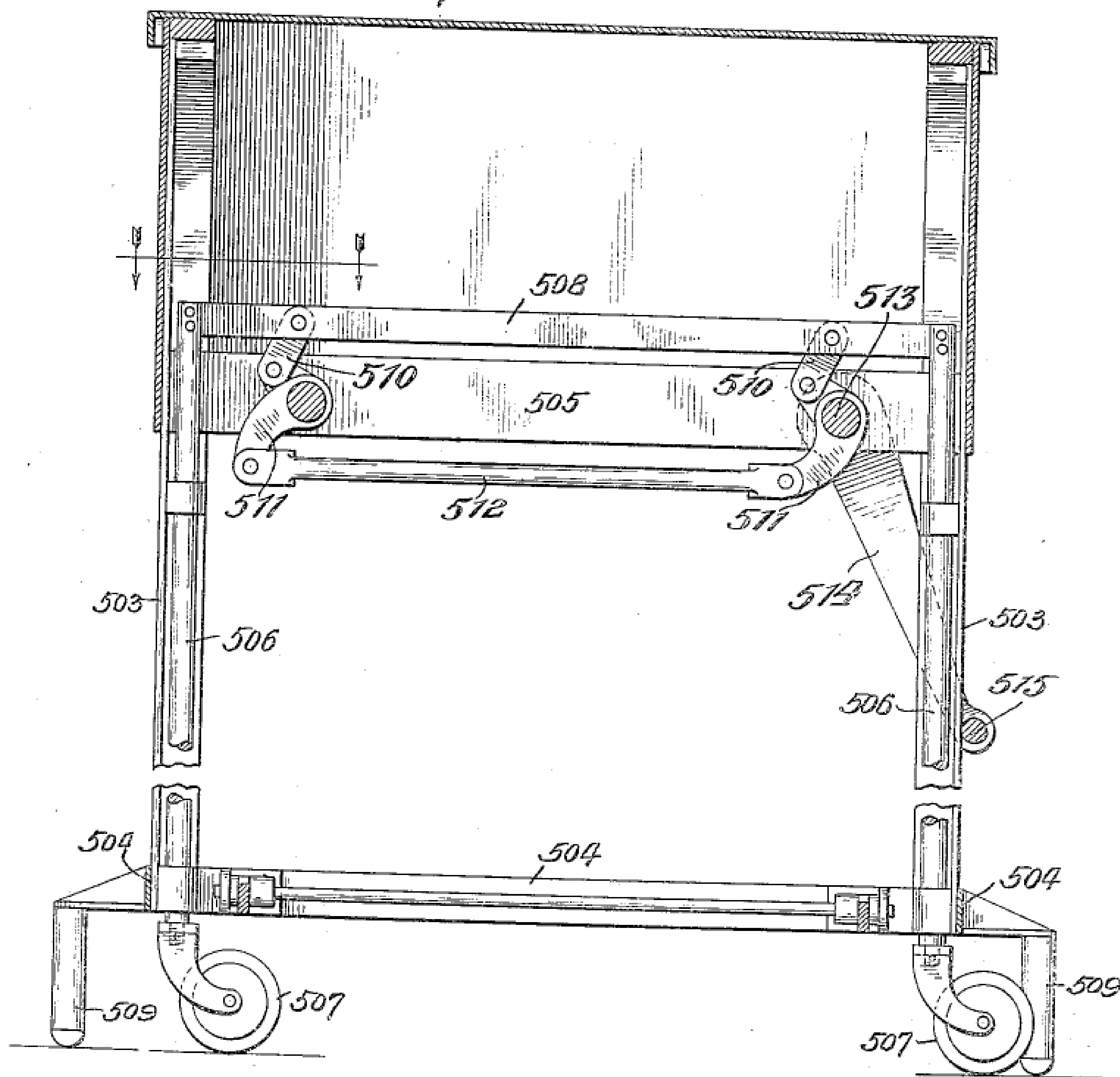
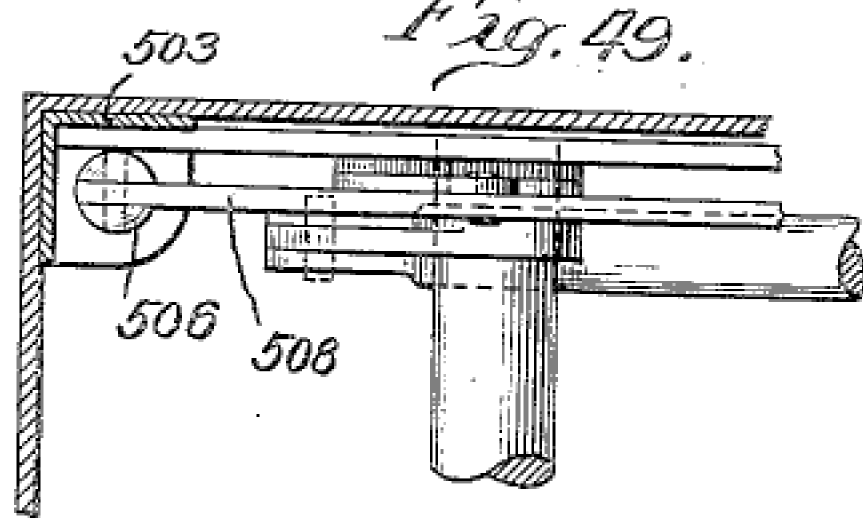


Fig. 49.



Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Martin Teetor
Wallace R Lane
Attorney.

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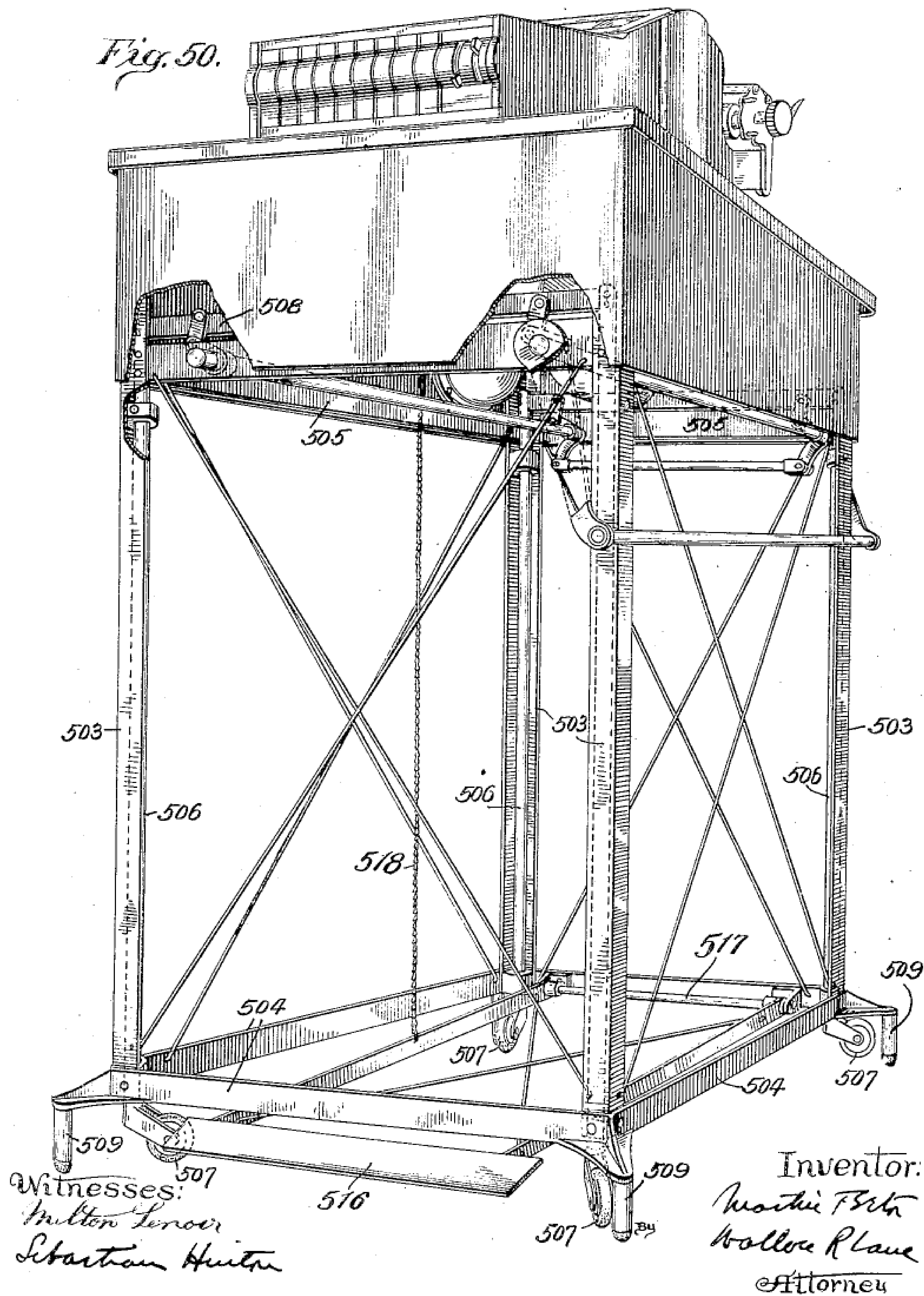
M. TEETOR.

CALCULATING MACHINE.

APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526. Patented Mar. 15, 1921.

26 SHEETS—SHEET 23.



Witnesses:
Milton Lenoir
Sebastian Hinton

Inventor:
Marthie Teetor
By Wallace R Lane
Attorney

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M. TEETOR.

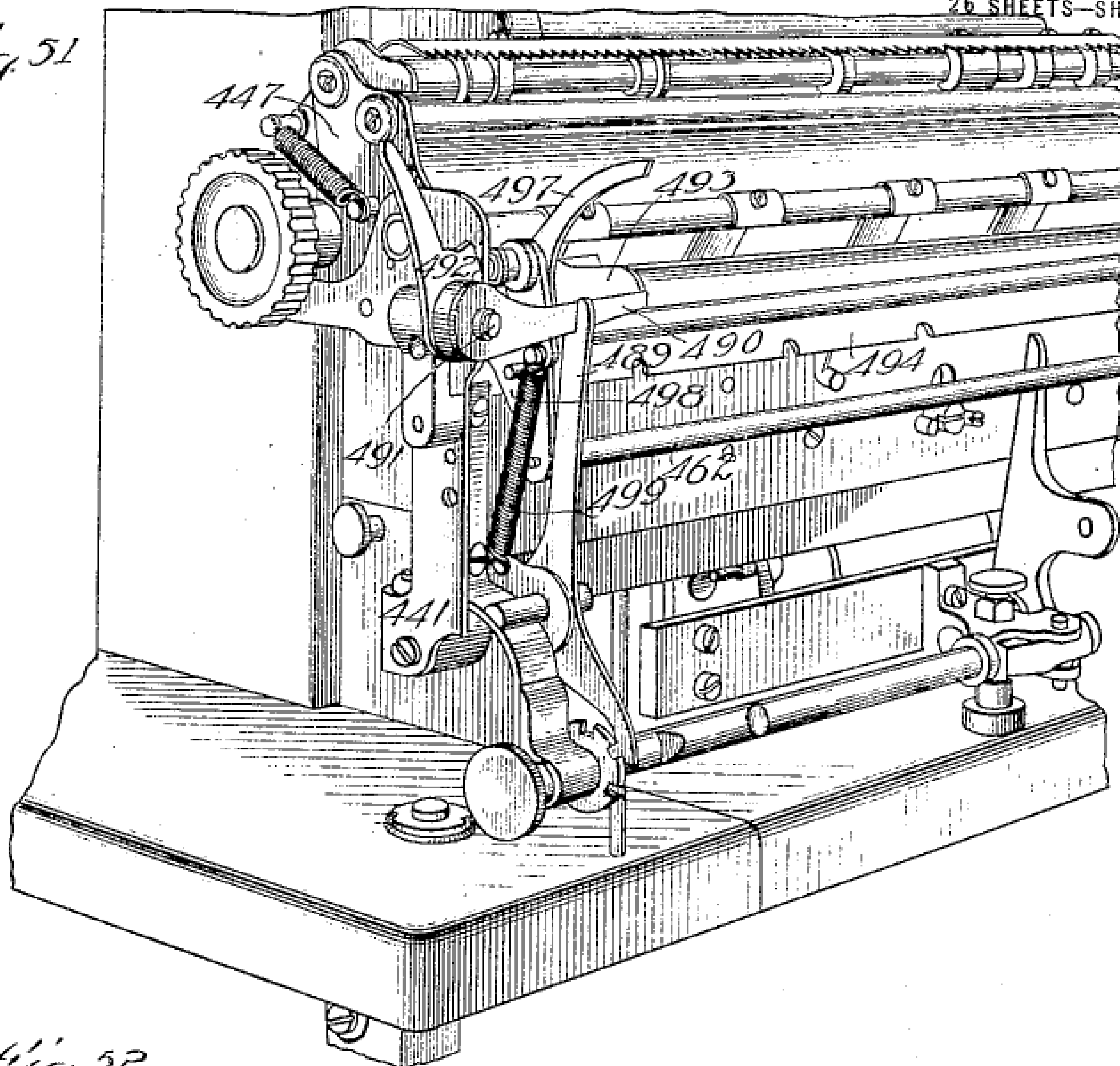
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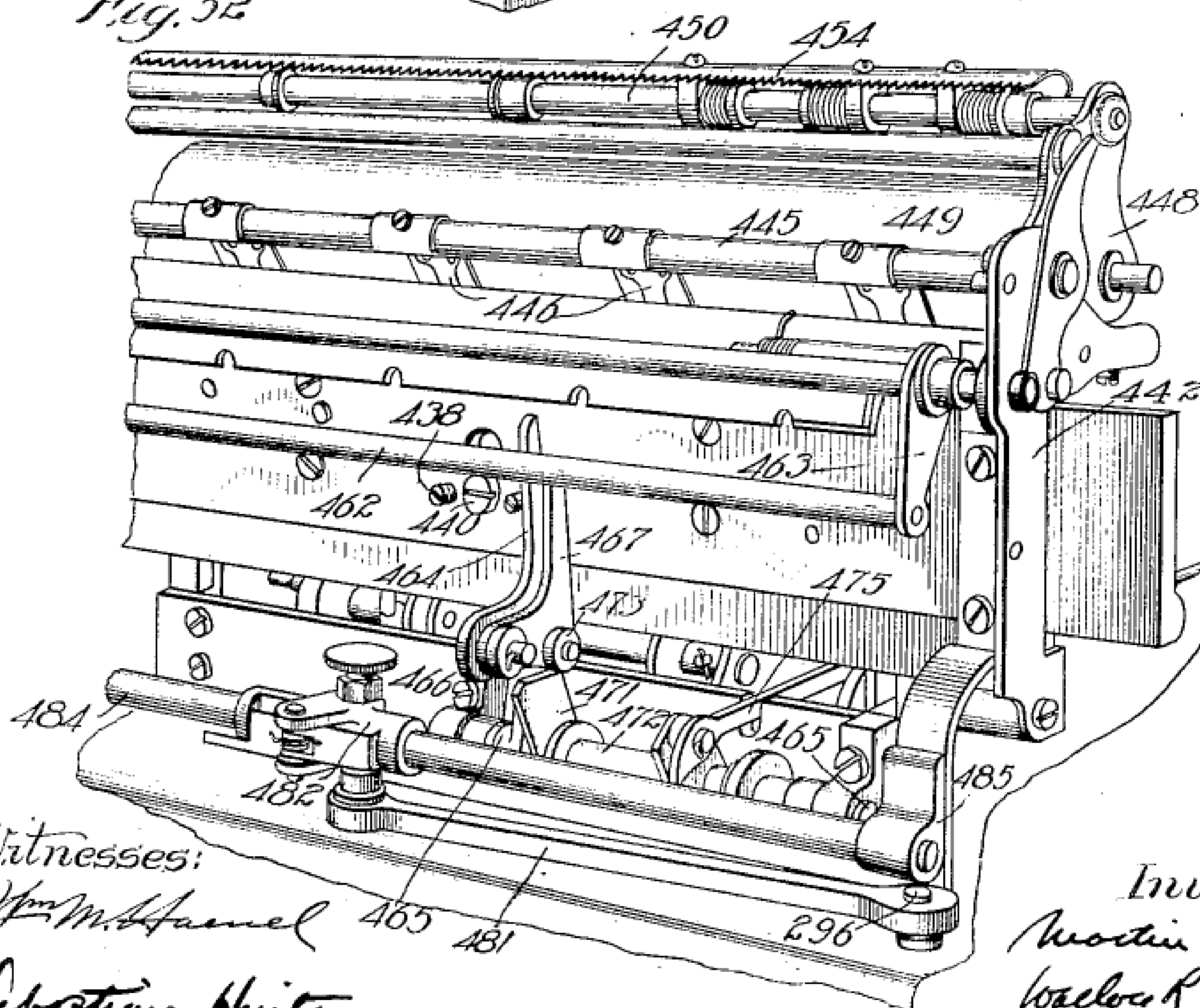
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

Patented Mar. 15, 1921.

26 SHEETS—SHEET 24.





Witnesses:

Wm M. Hamel

Sebastian Hinton

Inventor.

Martin Teetor

Wallace R Lane

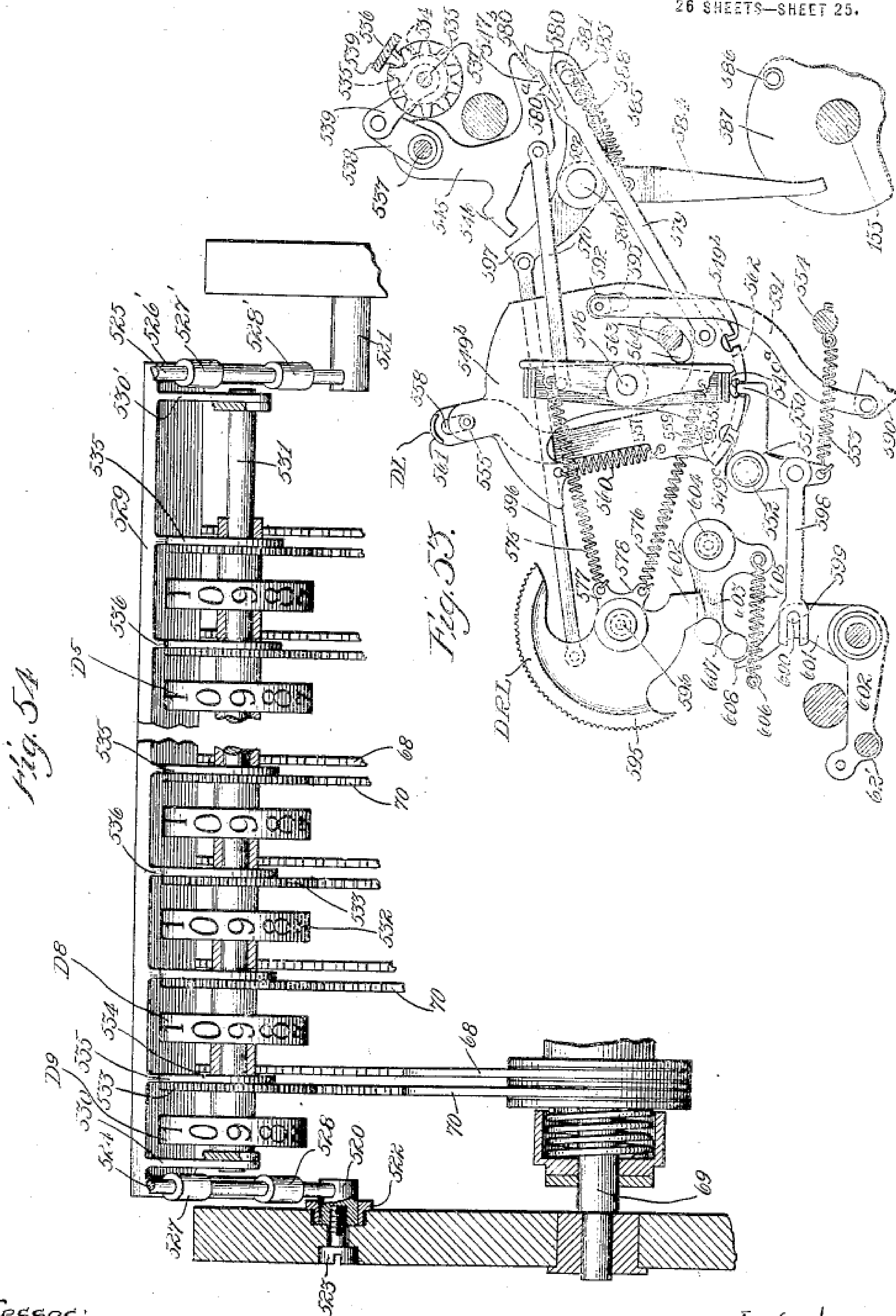
Attorney.

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M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

1,371,526.

Patented Mar. 15, 1921.
26 SHEETS—SHEET 25.



Witnesses:
Wm. Haenel
Sebastian Hinton

Inventor:
Martin Teetor
Wallace R. Lane
Attorney

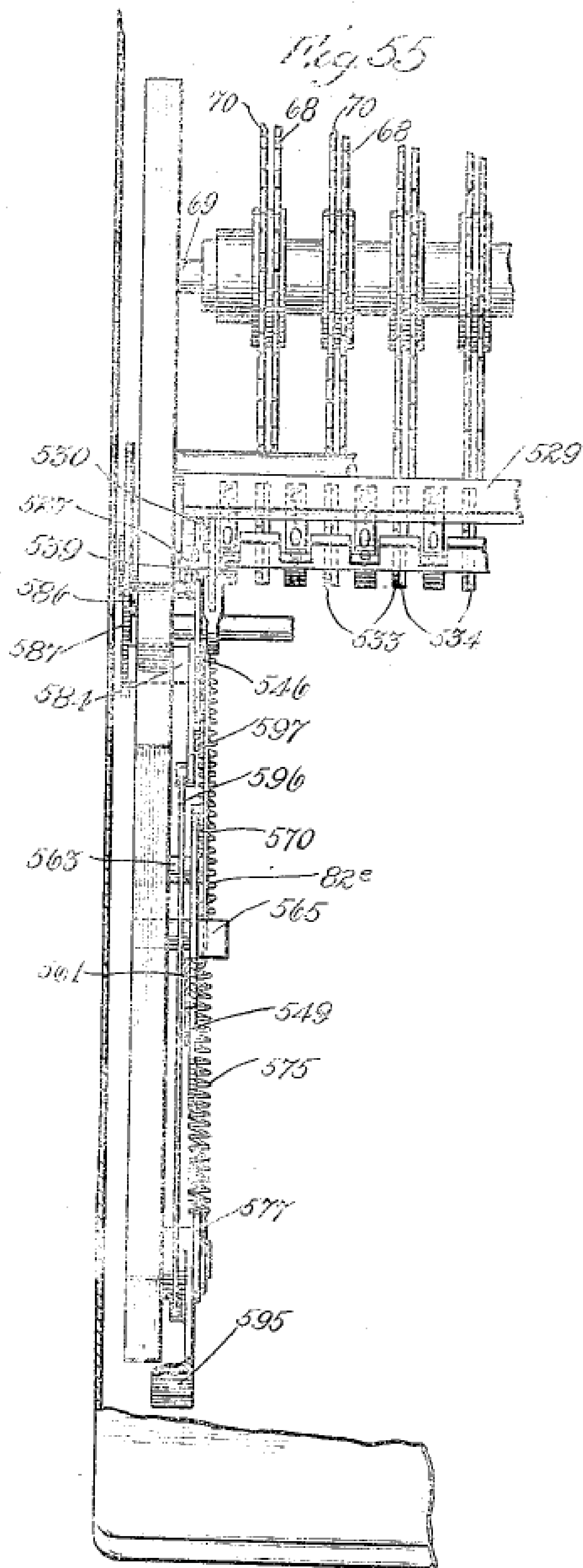
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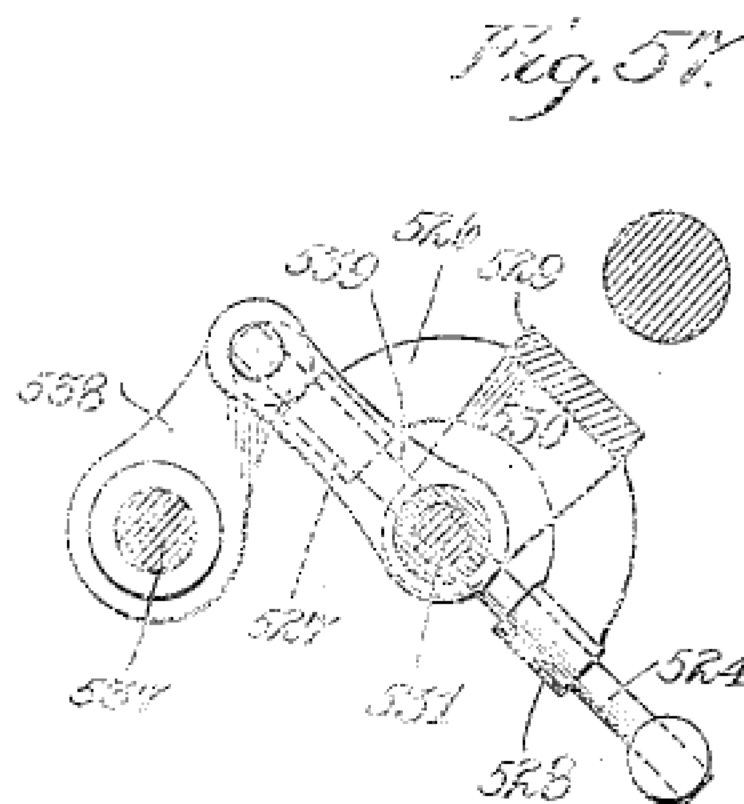
M. TEETOR.
CALCULATING MACHINE.
APPLICATION FILED APR. 18, 1914. RENEWED NOV. 24, 1919.

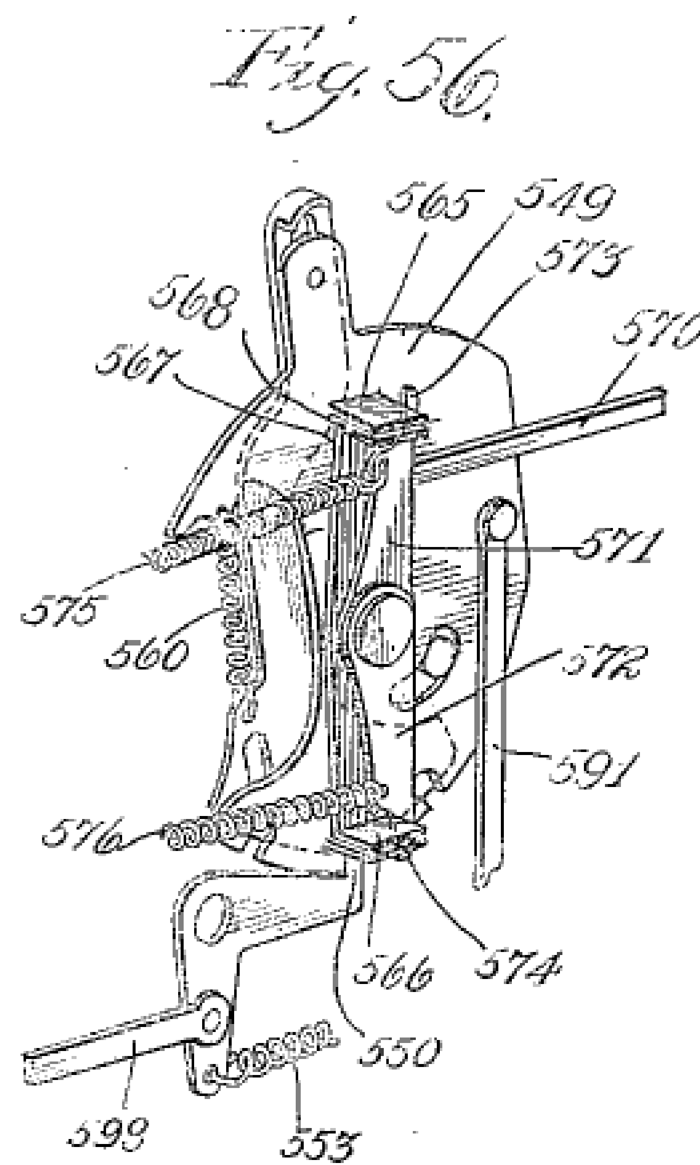
1,371,526.

Patented Mar. 15, 1921.

26 SHEETS—SHEET 26.







Witnesses:
[signature]
[signature]

Inventor:
Martin Teetor
Wallace R. Lane
Attorney

1921 03 15 US1371526 p26.png

UNITED STATES PATENT OFFICE.

MARTIN TEETOR, OF DES MOINES, IOWA, ASSIGNOR TO TEETOR COMPANY, OF DES MOINES, IOWA, A CORPORATION OF IOWA.

CALCULATING-MACHINE.

1,371,526. Specification of Letters Patent. **Patented Mar. 15, 1921.**

Application filed April 18, 1914, Serial No. 832,924. Renewed November 24, 1919. Serial No. 340,289.

To all whom it may concern:

Be it known that I, MARTIN TEETOR, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented new and useful Improvements in Calculating-Machines, of which the following is a specification.

My present invention includes many improvements in calculating machines, and effects some results not heretofore attainable and also effects some old results in a new and easier way and embraces many details of construction and advantageous arrangements of the several parts, new in this art, and coöperating to bring about the desired action of the mechanism as a whole.

A specific embodiment of the present invention is shown in the drawings and is described in detail in this specification. Some of the advantages will be pointed out in detail and others inherent in the construction will become apparent after comparison of the improvements here disclosed with other machines in this art.

Among the more salient features of novelty included in the present invention, mention may be be made of the following:

1. A key-board built up out of sections, anyone of which may be removed from the machine easily without disturbing the others and all of which may be made up of a standard size and as interchangeable elements and may be assembled in any one machine or transferred from one machine to another as desired. This results in an economy of manufacture and special convenience in assembly, more particularly in making up machines which are in some respects special or differing from standard. Also in the matter of equalizing the wear on different parts of the key-board or in shifting one section over to take the place of another, this feature is of extreme convenience and utility. With standard key-board sections on hand, machines of large or small capacity can be erected on short notice.

2. A rock shaft extending through the machine and carrying type bearing arms frictionally supported on and provided with an improved slip joint connection with this rock shaft so that they will swing with it as the rock shaft turns, but may be stopped at predetermined points in their travel to correspond with the set-up on the key-board of the machine, and affords a novel coaction with a rack arm also frictionally mounted on the rock shaft. This brings the appropriate printing type in position for making impressions on the paper or permanent record sheet at the rear of the machine. This affords a rigid and non-vibrating support for the type and also serves automatically to aline the swinging members, thereby obviating the use of guide fingers or combs.

3. A simplified arrangement of calculating wheels, and means regulated in movement by the set-up of the key-board to rotate these wheels, either forward or back as the case may be, to add or subtract items set up on the key-board, the rotation of these wheels being governed by improved mechanism carried by the rock shaft and having a novel arrangement of parts for "carrying over" or transferring from one wheel to the next, as the total within the machine increases or decreases in size in accordance with the items for subtraction or addition, set up on the key-board. The transfer mechanism is sectionalized and offers many advantages for commercial manufacture.

4. A printing mechanism having removable type heads or type carriers with a ribbon guard and having positive, double acting hammers and novel means for working and controlling the hammers, this printing mechanism having novel means for printing explanatory characters after the numerals printed on the paper, and thus representing something other than numbers to be added or subtracted, as for instance, invoice numbers or car numbers. The complete hammer section of the printing mechanism is so arranged with respect to the other elements of the machine that it can be quickly removed as a unit for inspection or repair.

5. Improved elements associated with the calculating wheels, whereby a total which has been recorded by the printing mechanism may either be retained in the calculating wheels or cleared therefrom as desired.

6. An improved carriage mechanism mounted at the rear of the machine and easily detachable as a unit, this carriage mechanism having improved ribbon shifting means, improved platen shifting means and being connected up for control from the front of the machine so that it may be shifted longitudinally to print in either of

two or more columns, as desired, this sliding or shifting carriage being power driven and positive in its action in either direction. The shifting of the carriage is of especial value in making up statements and bank balances or any records where debits and credits are to be compared, for the sliding movement can be governed for either position or retained at any position (to correct errors) by suitable manipulation of control mechanism at the key-board.

7. A locking mechanism to prevent the taking of a total when the machine has been operated below its normal (as in the case of over draft) or is operating nearly up to its full capacity. This prevents the machine from giving an erroneous total where the calculations have over run the machine in either direction.

8. Improved driving means whereby an electric motor or its equivalent may be thrown into driving relation with the machine at the will of the operator and may be used not only to swing the rock shaft with its load of type bearing levers and associated elements for actuating the calculating wheels, but also serves to shift the platen in either direction in case of two column printing. The driving connection between the motor and the driven parts is unusually direct, the normal speed of the motor being utilized to govern the normal speed of the machine as a whole, and the machine as a whole being relatively free from dash-pots, springs and similar protecting devices heretofore found very desirable and even necessary. The clutch mechanism whereby driving connection is established or interrupted between the motor and the calculator is of novel construction and particularly designed to give an easy start for the motor and a cushioned stop for the shifting carriage.

The above enumerated features and advantages of my invention are by no means the only ones, and others will become apparent from the following detailed description, and will be readily understood as inherent in the construction shown and will be appreciated by those familiar with the construction and mode of operation of machines of this general class.

In so far as it relates to the common subject-matter disclosed, this application is a continuation of application Serial Number 427,999, filed April 20, 1908, and application Serial Number 612,127, filed March 3, 1911, it being my express intention to prosecute in this application claims broad enough to read upon its disclosure and that of either of said two prior filed applications.

In the accompanying drawings, which form a part of this specification—

Figure 1 is a plan view of the machine, a portion of the supporting platform being broken away at the front to economize in space on the sheet.

Fig. 2 is a transverse section through the key-board and accumulating mechanism showing the hammer section in side elevation and omitting most of the platen, carriage and ribbon shift.

Fig. 3 shows one of the key-board sections on a larger scale, many of the keys and associated parts being omitted to simplify the figure.

Fig. 4 is a detail of the swinging stirrup and saddle which establish connection between each key-stem and its stop-wire.

Fig. 5 is a transverse section through one of the key-supporting plates illustrating particularly the elements associated with the key-stem.

Fig. 6 is a perspective illustration of the mechanism used to control the zero stop wire.

Fig. 7 is a horizontal section taken through the structure of Fig. 3 just above the sliding plate 20.

Fig. 8 is a longitudinal section through the machine just inside the right hand side plate and shows particularly the control elements whereby the various operations of which the machine is capable, are determined.

Fig. 9 is a view looking in the opposite direction, the section being taken just inside of the control mechanism and between that mechanism and the first key-board section.

Fig. 10 shows the controlling elements positioned at the left hand side of the machine.

Fig. 11 is a perspective view of the lever L and the reversing gear governed thereby, whereby the machine is shifted over from an adding machine to a subtracting machine.

Fig. 12 is a detail of the tension device appearing at the center of Fig. 11 and whereby the in and out snapping of the pinions is determined.

Fig. 13 is a side elevation of the eliminating lever including its connections running through to coöperate with some of the parts shown in Fig. 11 to hold the accumulator out of action while permitting the printing device to record an invoice number or the like.

Fig. 14 is a detail of the sub-total lever.

Fig. 15 shows the connections between the sub-total lever and the total lever.

Fig. 16 shows how the total lever is connected up with the sliding notched plate whereby the identifying character to be printed on the record at the side of the numbers, is determined.

Fig. 17 is a side elevation of one section of the accumulator, illustrating the latching device which governs the slip between the

stop-nose and its rack and thus controls the transferring or carrying over from one section to the next.

Fig. 18 is a front view of the structure shown in Fig. 17 partly in section and viewed in the direction indicated by the arrows Fig. 17.

Fig. 19 is a horizontal section showing in plan the main rock shaft and the swinging type arms, and also certain of the other parts.

Fig. 20 is a sectional detail of the slip joint whereby the stop noses and the swinging racks are slung from the main rock shaft.

Fig. 21 is an elevation of one of the side plates hammer section, and

Fig. 22 shows the other side of that section.

Fig. 23 is a transverse section illustrating the hammers and their relation to the printing heads and showing the means whereby the hammers are actuated or are locked against action.

Fig. 24 is a rear view of the hammer section, certain parts being broken away to show how one hammer may be made to carry across to the next when zeros are to be printed in after a numeral.

Fig. 25 illustrates the detachable printing head with its side plate forming a ribbon guard.

Fig. 26 is a detail of the type head showing the type and their respective springs in section.

Fig. 27 is a perspective view of one of the type showing the pin used for engagement with its controlling spring.

Fig. 28 is a plan view partly in section of the ribbon carrier.

Figs. 29 and 30 are details of the cam mechanism utilized in reversing the direction in which the spools rotate to shift the ribbon.

Fig. 31 is a transverse section through the ribbon drums illustrating the swinging flaps used for starting the gears to shift the cam of Fig. 29 when the direction of a ribbon movement is to be altered.

Fig. 32 is a perspective view of one of the ribbon spools and its associated parts.

Fig. 33 is a vertical section through a ribbon spool showing in section the plate used as a dog to rotate that spool and also illustrating the toggle mechanism whereby the spool may be raised and lowered to shift the ribbon vertically and thus equalize the wear thereon.

Fig. 34 shows one of the ribbon spools in elevation and the platen carriage in section and is taken along the line B—B of Fig. 37.

Fig. 35 is a similar section taken on the line C—C of Fig. 37.

Fig. 36 is a detail of the bar positioned at the lower edge of the platen carriage through which connection is established to the motor so that the carriage may be shifted back and forth at the rear of the machine to print in two or more columns.

Fig. 37 is a plan view of the detachable platen carriage showing the relative positions of the ribbon carrier, the platen and rolls of paper.

Figs. 38 and 39 illustrate the locking plate whereby the platen carriage may be locked against longitudinal movement as when all the numerals are printed in a single column.

Fig. 40 shows the over-draft control mechanism and also the control mechanism for the ribbon shift and for the platen feed, these elements being located in the rear left hand corner of the machine and being shown in Fig. 40 as looking toward the right.

Fig. 41 shows some of the parts of Fig. 40 as viewed from the rear of the machine.

Fig. 42 illustrates the motor control at the right hand side of the machine and particularly the clutch mechanism, whereby the continuously rotating motor may be connected in to actuate the main drive shaft of the machine.

Fig. 43 shows the motor shaft and the worm gear used for reducing the speed.

Fig. 44 is a transverse section through the worm gear drive showing the concentric tubes whereon are mounted the ratchet wheels, one used for connecting the motor to drive the calculating mechanism and the other used for connecting the motor to shift the platen carriage.

Fig. 45 is a perspective view of the ratchet and clutch mechanism on the right hand side of the machine, whereby the motor is connected in to drive the calculating mechanism.

Fig. 46 shows the clutch mechanism on the left hand side of the machine, whereby connection is established between the continuously rotating motor and the carriage, so that the carriage may be shifted from side to side to print added items in one column and subtracted items in another and to otherwise regulate the shifting movement of the platen carriage.

Fig. 47 is a perspective view of the clutch mechanism of Fig. 46.

Fig. 48 shows in section the adjustable stand whereon all the operating parts are carried and illustrates particularly the vertical adjustment whereby the weight may be transferred from casters to stationary feet.

Fig. 49 is a detail of the toggle connection for shifting the weight from the casters to the feet.

Fig. 50 is a perspective view of the complete machine mounted on its stand, parts being broken away to show the toggle connection whereby the operator in pulling up

on the handle or rail at the side of the machine, can transfer the weight to the casters and is thus able to trundle the machine from place to place.

Figs. 51 and 52 are perspective views of the sliding carriage and its coöperating parts as seen from the rear of the machine with the detachable paper support removed.

Fig. 53 is a side elevation on a reduced scale of the duplicator mechanism showing certain parts of the machine in section.

Fig. 54 is a partial front elevation of the same partly in section.

Fig. 55 is a partial plan view of the same partly in section.

Fig. 56 is a perspective of the control plate and associated parts of the duplicator.

Fig. 57 is an elevation partly in section of the sliding table construction carrying the duplicator pinions.

General operation.

Fig. 1.

Before describing in detail the construction and operation of the various mechanisms which go to make up the complete machine, it may be profitable to set forth in general language, a statement of some of the various operations of which the machine is capable.

Referring to Fig. 1 which is a plan view of the machine, it will be seen that the sectionalized key-board is in the usual position at the front of the machine and easily accessible to the hand of the operator. The carriage mechanism whereon the rolls or sheets of paper are supported, is at the back of the machine where it can be shifted either to the right or to the left, as occasion may require to print the items in one or more columns and to furnish a permanent record of the operations going on within the machine. Most of the control levers and similar devices are at the right hand of the machine, easily accessible to the hand which operates the keys, thereby making the machine essentially a one hand machine.

The keys of the sectionalized key-board are grouped in accordance with standard practice. Nine sets of keys are here shown, but it will be understood that more or less may be used if desired. These nine sections are numbered respectively S_1, S_2—etc. to S_9. When any one of these nine sections is removed from the key-board, as for inspection or repair, it takes with it a portion of the internal mechanism of the machine, without, however, disturbing other sections or involving any material changes within the body of the machine.

Above the key-board is a window or series of windows at which numeral wheels N_1, N_2,—N_9, and preferably some distance below them the wheels D_1, D_2,—D_9, are visible, it being understood that the wheels N_1, etc. form part of the calculating mechanism and that the total in the calculating mechanism may, at any time, be read off them, while the wheels D_1, D_2,—D_9 are the duplicator wheels for retaining any number used in the calculations performed on the machine. The action of all these wheels may here be observed at all times, this being always a convenience to the operator and a necessity in some cases.

At the extreme right hand edge of the key-board is a rail R which may be called the tripping rail and which is so connected that the operator can touch it with the side of his hand without removing his fingers from the key-board. When this rail is touched, the driving motor is thrown into driving connection with the machine and turns it through one complete stroke, causing whatever operation may have been arranged for previously to be performed, or the tripper rail may be held down by the operator to repeat the operation, as when the same number is to be repeatedly recorded.

Also at the right hand of the machine is a lever L which can be swung either rearwardly (away from the operator) or forwardly (toward the operator). In the rearward position it sets the machine for adding, and in the forward position it sets the machine for subtracting. For example when it is desired to enter a certain number in the machine in a positive or adding direction, the lever L is thrown rearwardly as shown in Fig. 1, either before or after the setting up of the key-board and then the operator touches the rail R, tripping the clutch which connects the electric motor with the power shaft of the machine, and so rotating the calculator wheels to store up the number which had been set up on the key-board. Simultaneously, this number is printed on the paper roll or sheet at the rear of the machine, the platen is shifted to advance the paper, and as a part of the operation, the printing ribbon is shifted to present a fresh surface and other incidental operations are automatically carried through.

A second item set up on the key-board may in similar manner be carried through to the numeral wheels, which by their rotaton will add the number to the amount already indicated by the wheels, it being understood that this second item will simultaneously be printed on the sheet of paper at the rear of the machine.

The printing and carriage mechanisms are normally always in operative relation so that any numbers set up on the key-board and transferred through to the numeral wheels will simultaneously be printed at the rear of the machine in such a way as to yield a permanent record of the operation.

Other items may be added in, one after the other, each item serving to rotate the numeral wheels still further and so building up the total as indicated by these wheels as they appear through the windows.

When it is desired to subtract an item from another or from the total of previous additions or subtractions, the control lever L is thrown forward or toward the operator, into the subtracting position, either before or after the number is set up on the key-board, whereupon the tripping of the rail R will again turn the machine over, but this time the numeral wheels will back up by an amount corresponding to the set-up on the key-board, thereby, in effect, mechanically subtracting the number thus set up. Of course when lever L is swung forward, certain changes are effected within the machine whereby this reversal in the direction of rotation of the numeral wheels is brought about, but those changes need not be discussed at this point.

The items to be subtracted are printed at the rear of the machine, but previous to that printing, the platen frame may be shifted over far enough to print the subtracted item in a separate column, so that added numbers are printed in one column, which may be called the adding column, and subtracted numbers are printed in an adjacent column, which may be called the subtracting column. However, it is possible with this machine to print both added and subtracted numbers in either the adding column or the subtracting column and this result is effected through manipulation of the carriage lock CL at the left hand side of the machine, it being the function of this lock to hold the carriage against movement so that if locked while alined for the adding column it will continue to rest in that column whether the items are being added or subtracted at the numeral wheels and similarly of course, if the carriage be locked in the subtracting position, all the items will be listed one after the other in the subtracting column even though some of them may be items actually added in at the numeral wheels.

At any time during the operation of the machine, it is possible to subtract out a number which has been added in by mistake (or similarly to add in a number subtracted by mistake) without allowing the carriage to shift over to the opposite column preparatory to making the correction, it being only necessary to throw the carriage lock CL and hold the carriage in the position which it had when the erroneous item was put into the machine.

In speaking of these columns as the adding column and subtracting column, it will be understood that this is but an arbitrary nomenclature and that a large value of the shifting carriage lies in the capacity of the machine for printing in one column the added items of an account and in another column the subtracted items and ultimately printing the difference between debits or credits instantly on the next following stroke and in the proper column. By putting the carriage in the proper column at the beginning, the added items may all be put in the right hand column and the subtracted items in the left, as in case of bank statements, or the added items may be on the left and the subtracted items on the right, as in the case of the ordinary mercantile statements. The carriage can be tripped over from one column to the other, preliminary to printing, by the operator, in several different ways, as for instance by merely snapping the total lever TL far enough to unlatch the carriage, but ordinarily it is controlled automatically by the forward or rearward swing of the lever L.

In order to definitely identify negative items, no matter whether they are printed in a column by themselves or mixed in with positive items, a suitable character or mark is printed at the side of the number, as for instance a minus sign, and this indicates that the particular entry is of negative character and was subtracted. The identifying character is printed in automatically whenever a negative entry is made, no manipulation of the machine on the part of the attendant being necessary.

Since the numeral wheels are actuated in a positive direction when the lever L is set for adding, and in the negative or reverse direction when the lever L is set for subtraction, it is obvious that the indications of the numeral wheels as they appear at the windows, will be, at any time, the arithmetic sum of the numbers entered into the machine, since its last clearing, and exclusive of any "eliminated numbers" to be described.

The machine is provided with a total taking lever TL which in its rear position, as shown in Fig. 1 is inactive and allows the machine to list the items, one by one as they are set up on the key-board. To take a total and to print the total on the record sheet, the operator pulls down the total lever TL, thereby shifting mechanism within the machine in such a way that the total as set up on the numeral wheels is backed out from those wheels when the machine is next turned over, thereby returning the wheels to their cipher positions, whereupon they shift out of mesh with their actuating racks and the racks are allowed to return to normal. This leaves all of the number wheels at their initial or zero position. This backing out or unreeling of the numeral wheels serves to set up the printing mechanism so that it will print the total amount backed

out from the wheels. In other words, if the machine be turned over with the total lever TL forward or in its total-taking position, the operator clears the numeral wheels and simultaneously prints the total as shown by those wheels. To throw the machine into driving relation with its motor for printing this total, it is only necessary to trip the rail R exactly as if an item were being added or subtracted.

To retain the total in the machine (commonly called sub-totaling) the sub-total lever STL as well as the lever TL must be pulled down into their lowermost positions. These two levers are so locked that while TL can be pulled down without moving STL, it is not possible to pull STL down without its pulling TL with it. With STL and TL in their lowermost positions the machine, when turned over by tripping rail R, will back out the total from the numeral wheels, thereby setting up the printing mechanism to print that total, and then by retaining the wheels in mesh will again return them to their previous setting or in other words leave the machine with the total still in it.

In many machines it is considered necessary to lock the key-board or to lock the keys against movement when a total is to be taken, otherwise the machine may either print an erroneous total or be damaged. In the machine of my present invention the key-board is not locked and yet the total cannot be tampered with and the operation of taking that total does not endanger the mechanism. This result is brought about by swinging the stop wires of the key mechanism forward out of stopping position, through the instrumentality of a rock shaft connected through suitable connections with the total lever TL, so that when this lever is thrown forward into its total taking position, the stop wires are out of the path of the swinging elements within the machine. Although the keys are not locked against movement they are effectually isolated from the rest of the machine during total taking and none of them can have any effect on the total or interfere with the swinging elements.

It is sometimes convenient, and even necessary, to enter a number on the printed record without adding it in at the calculating wheels, as for instance when the number of a railway car or the number of an invoice or other identifying data is to be put in as explanatory of the real numbers to be added or subtracted. In order to cause the printing of such explanatory items without actuating the calculating wheels, there is provided at the front of the machine an eliminating lever EL which serves to eliminate or keep out of the calculating mechanism the explanatory numbers which are to be printed on the permanent record. With the lever EL in its lower position, it is in its normal or inactive position, and when raised, it is in position to compel the entry on the printed record of the number set up on the key-board without allowing that set up to act on the calculator wheels. When such an explanatory or identifying number is printed on the record, there is also printed simultaneously and automatically an explanatory character in the nature of some special mark following the number, this character being sufficient to show that it is a box car number or the number of a bill of lading or something of that sort and is not one of the numbers added or subtracted by the calculator mechanism.

Repeating mechanism is also provided so that the same item can be entered several times in succession, without the necessity for setting up the key-board at each operation. This result is effected through use of a repeating lever RL at the front of the machine, Fig. 1, which when drawn down puts the machine in condition for repeating the number previously set up on the key-board. In a general way it may be said that this action is brought about by restraining the operation of the rocker normally used to clear the key-board. In other words it renders the key restoring means inoperative and leaves the keyboard set up for repetition as often as the machine is turned over.

At the front end of each of the sections of the key-board is a correction key CK which when depressed restores all of the keys to their raised position and clears out that particular section leaving it ready for a new impression. Thus when through error, the key-board has been set up with the wrong number, such of the digits as may be in error may be cleared out by depressing the correction key for their own sections of the key-board and thereupon the correct key manipulation may be made and the machine put in condition for turning over to print the corrected number and adding or subtracting at the calculator wheels. As a short cut to extensive corrections of this character, the total lever TL may be swung down and back thereby clearing the entire key-board but without affecting the calculator wheels or printing the item.

When an operator steps up to the machine to use it, he first wants to know whether the machine has been cleared at the end of its previous operation. In other machines, it is ordinarily necessary to take a spacing stroke (to release the total mechanism) and then with the total button down to take a printing stroke so that if there is a total in the machine, it will be printed on the paper. If there is no total in the machine the imprint will show that the machine is clear. In the machine of my inven-

tion, on the contrary, it is possible to ascertain whether the machine is clear without this spacing stroke simply by glancing at the numeral wheels at the windows.

But if a permanent record is desired on the paper, the proceeding is as follows: If the machine has been left in its total taking adjustment, with the lever TL in its down position, the next operation of the machine will print the total (if there is a total in the machine) or will print merely the usual total character (if the machine was cleared by the operator who used it last). Inasmuch as the identifying character for a total is different from the identifying character of a sub-total, the printed record will always show whether a previous total left in the machine has been added into the new account or has merely been printed on the record simultaneously with clearing from the numeral wheels. This allows the operator to subtract it out later on, if through mistake it has been added in at the beginning.

The machine is also provided with means for indicating when it is being worked beyond its limit point. There is provided a printing character which comes into play, serving as a warning to the operator that he is in danger of getting a misleading total. In the case of an over-draft, the identifying or warning character comes into action immediately, and so long as the operator is beyond the negative limit with the machine in the subtracting position, this identifying character will be repeated after each item, even though the over-draft be no more than a cent. The warning character does not appear after items which are being added in to wipe out an over-draft as would be the case in a banking account where deposits are made which tend to reduce the over-draft of the account. After an over-draft has been completely wiped out, the warning character will disappear from the record and the machine having been returned from its abnormal condition beyond the limit point, will continue to add and subtract and will give the totals in the normal way.

The machine is so adjusted that when it is working beyond the limit point, either positively or negatively, (either when the machine is nearly full or when there has been an over-draft) the total taking mechanism will be automatically locked so that the operator cannot possibly take a total until the machine has been returned from its abnormal condition or from beyond the limit point.

The machine is also provided with what I have termed a duplicating mechanism whereby any number at the time of its entry into the machine can be stored up in an auxiliary set of number wheels without interfering with whatever operation the machine is being called upon to perform and retained indefinitely until the operator at some future period desires to redeliver this number to the machine for any purpose. The number so stored up in the machine may be redelivered to the machine and cleared from the duplicator numeral wheels or redelivered to the machine and retained in the duplicator numeral wheels just as the operator desires. The controls for this mechanism are shown in Fig. 1, wherein DL represents the duplicator lever. When it is desired to store up some number, for instance the number of a bill of lading or a box car number, independent of the calculating or printing parts of the machine, for future redelivery to the machine, the operator shifts the lever DL forwardly, whereupon the number is rolled into the duplicating numeral wheels D_1, to D_9, upon the turn-over of the machine, whatever operation the machine may be performing with that number. The lever DL is returned after this turn-over of the machine to its central position shown in Fig. 1. When the operator desires to redeliver this number thus set up in the numeral wheels D_1 to D_9 he shifts the duplicator lever backward whereupon this number is delivered to the machine precisely as if it had been set up on the key-board to be employed in any operation of which the machine is capable, and at the same time cleared from the duplicator pinions D_1 to D_9. If the operator desires to retain the number in the duplicator numeral wheels D_1 to D_9 upon redelivery of that number to the machine, he operates the levers DL and DRL whereupon the number will be re-delivered to the machine but also retained in the duplicator numeral wheels D_1 to D_9.

The various functions and operations of the machine above briefly set forth, indicate in but a very general way the capacities of the particular embodiment shown in the drawings and set forth in the following detailed description. Many other features of novelty might be mentioned in this preliminary statement, but these features will become apparent after a detailed description of the drawings, which description here follows:

Key-board.

(Figs. 1, 2, 3, 4, 5, 6 and 7.)

Fig. 1 illustrates the separate keyboard sections S_1, S_2, S_3—S_9, any one of which may be removed from the machine in a very simple way without disturbing any of the others and even without interfering with the further normal operation of the others.

Fig. 2 shows one of the sections in its operative position, and

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Fig. 3 is a diagrammatic or simplified view of enough parts to show how a key-board section operates.

The casing of the machine comprises a base-plate 1, and is equipped with a suitable covering hood having sides 2 and 3 and a top 4, the top being provided with a glazed opening 5 exposing the little windows at which the numeral wheels N_1, N_2, N_3,—N_9 appear.

Each key-board section comprises a wall plate 6 arranged to support the key-stems, stop wires and other operative parts of the section. At its front the plate carries a flange 7 as wide as the operative parts of the section and serving to close the front of the key-board when the key-board is completely assembled. At the top edge of plate 6 is a flange or transverse plate 8 having slots to receive the key-stems. The keys K_1, K_2,—K_9, are mounted respectively on corresponding key-stems 9 each of which has a projection 10 to limit its downward movement and each of which carries near its lower end a forwardly projecting lug 11 serving as a cam to actuate a stop-wire and also serving as a stop to prevent upward movement of the stem until it has been released subsequent to fulfilling its function in holding the set-up until the machine is operated.

Coöperating with this lug 11 is a swinging stirrup 12 (Figs. 3 and 4) pivoted at 13 and urged toward the key-stem by a saddle-shaped arm 14 also pivoted at 13 and having a projection 15 constantly urged downward by the pull of a coil spring 16. The upper end of this saddle 14 is pivotally connected at 17 to a stop wire 18 the outer end of which is bent at a right angle as at 18′ and is suitably guided to serve as a stop for mechanism associated with the calculating wheels and printing mechanism. The lower end of each key-stem extends downward almost to the lower edge of plate 6, though in Figs. 2 and 3 that lower portion of each stem is in large measure concealed by the corresponding coiled spring 16. The extreme lower end of each key-stem is bent transversely and is attached to the lower end of spring 16 so that this spring fulfils not only the function of pulling down on the saddle arm 15 to urge the stop-wire 18 forward into stopping position whenever a key is depressed far enough to allow the stirrup 12 to swing in over lug 11, but it also serves the function of forcing the key-stem upward after the machine has acted and when the key-stem is to be returned to normal.

Projecting downward from each stirrup 12 is an arm 19 which is used to unlatch the stirrup from the lug 11 of the key-stem when the keys are to be returned to normal and also serves to positively restore the corresponding stop to normal. As a means for actuating this arm 19 there is provided a plate 20 slidingly mounted against the supporting face 6 of the section and having lugs 21 extending transversely in position to strike arms 19 when plate 20 is shifted longitudinally. As a means for shifting this releasing plate there is provided at its lower edge a lug or shoulder 22 positioned above a rock shaft 23 which has rigidly mounted on it a striking blade 24 positioned to swing around into contact with lug 22 at each operation of the machine, pushing that hook to the right (Fig. 3) and shifting the releasing plate 20 far enough to bring lugs 21 into engagement with arms 19, thereby swinging the stirrups away from lugs 11 and allowing the keys to return to normal. A coiled spring 25 attached to the rear end of the releasing plate 20 serves to restore that plate to normal after rock shaft 23 has turned back.

When a total is to be taken, this longitudinal shifting of the release plate is effected by means of another rock shaft, this being indicated in Fig. 3 by the reference numeral 26. This rock shaft carries a striking plate 27 for engagement with lug 28 on the lower edge of the releasing plate. This insures that all the stop wires will be "in the clear" or in the withdrawn position during totaling and prevents tampering with the total through manipulation of the key-board.

In case corrections are to be made in the setting of the keys in any section, to clear out an erroneous set-up, preparatory to operation of the machine, recourse may be had to the correction key CK at the front end of each section, this key being movable downward against the tension of a coiled spring 29 and having its lower end pivotally connected at 30 to a bell crank 31 swinging about a pivot 32 and having its upper arm pivoted at 33 to a sliding link 34, the rear portion of which is notched to engage a lug 35 projecting from the side of the releasing plate 20. As a result, the downward movement of the releasing key pushes the link 34 toward the rear of the machine and shoves the correction plate 20 longitudinally and far enough to release all the keys in that section, allowing them to return to normal. This sliding link 34 is so supported that it can be swung upward out of engagement with the stop 35 so that after the machine has once started on its swing, the operator will be unable to change the key-board setting by manipulating the correction key CK. In other words the correction keys are thrown out of operative connection with the sliding plate 20 at each operation of the machine, just preparatory

to the swing of the machine, and that connection is not reëstablished until the machine has swung back to normal. To effect this result, the rear of link 34 is bent downward and provided with a foot 36 which bears on a rocker bar 37 which moves upwardly at the beginning of each stroke of the machine to swing link 34 upward as described into the position indicated in dotted lines Fig. 3 and it stays up until the very end of the stroke.

The details at the lower edge of plate 6 appear in Figs. 3, 5 and 7 and include three staffs, 38, 39, and 40, which slidingly support the releasing plate 20, these staffs also carrying spaced plates 41 between which the lower end of the key-stems are guided and below which the hooked ends of the stems protrude for engagement with their respective coiled springs 16. One of these plates serves as a stop to limit the upward movement of the key-stem. The plates 41 are held in position by a brass rod 42 which extends longitudinally of the plates through all three of the staffs 38, 39 and 40. This brass rod is in the nature of a key, the withdrawal of which releases the outermost plate 41 and permits removal of all the stirrups 12 and saddles 14 as soon as their springs 16 are unhooked and then allows all of the key-stems to be drawn out through the top plate 8 and all of the stop wires 18 to be pulled forward out of their slots and removed from their section. In regular course of assembly, the workmen put these parts together without mechanical tools, using only their fingers to slip the parts in place then hooking the retaining springs 16 and sliding in the locking key or wire 42.

Each time any one of the keys of a section is depressed, a shoulder 43 near the upper end of the key-stem comes into driving engagement with a roller carried on a stud 44 projecting from a plate 45 mounted near the top of the section and swinging from three pivotal links 46. The main function of this sliding plate 45 is to pull forward on the cipher stop as soon as any item has been put in on the key-board by depression of any of the keys. This result is effected through a pivoted link 47 (Figs. 3 and 6) the rear end of which has a hook engaging with roller 48 carried on a swinging plate 49 pivoted at 50 and carrying at its lower end a pivotally supported stop-wire 51, (this being the zero or cipher stop wire) the bent end of which slides in the zero slot of a pair of guiding segment plates 52. A coiled spring 53 normally pulls plate 45 rearwardly and also pulls the upper corner of plate 49 forwardly and so serves the double function of returning plate 45 to normal and resetting stop-wire 51 after each operation.

As a means for returning the zero stop-wire to its acting position as soon as possible there is provided a vertically sliding plate 54 the upper end of which has a slotted engagement with link 47 at 55 and the lower end of which is slotted to receive a vertically movable control rod 56 (Fig. 3) which is moved upwardly and downwardly in a positive manner at each operation of the machine and which pulls down on plate 54 just after the swinging arm or stop nose SN of the machine has passed stop-wire 51, thereby releasing the bell-crank 49 and allowing its lower end to re-set the zero stop.

It is not possible for the zero stop to hold the nose during a part of the forward swing and then release it for the balance of the swing for after the swing once begins the zero wire is effectively disconnected from the key-board and depression of keys will not withdraw it. As soon as the forward swing is complete the zero stop comes into action again and can be withdrawn by depression of a key even though the stop nose is on its return swing.

It will thus be understood that at each operation of the machine and properly timed with respect thereto, the control rod 56 moves down and stays down until the cycle has been completed or until the machine is again almost at rest, thus allowing the zero stop wire to move into stopping position the instant the stop nose has gone past it but giving the operator a chance to press down a new key set-up the instant the stop nose begins to swing back, or in other words, at the completion of a half stroke. And the keys may then be depressed even though their stop wires happen to be in the path of the upwardly swinging nose, for in that case the nose will simply brush them back and slip past, the wires then returning to their set positions. The operator therefore can be very deliberate in working the keys for he has 50% of the total time of a complete cycle wherein to set the keys for the next operation as compared with 10% or so on the machines more generally in use. The return or upward movement of plate 54 will withdraw the zero stop, if in the meantime any key has been depressed so that the machine may make another downward swing instantly on return from, or completion of, the previous swing. If the operator wants to repeat an item he can do so by simply holding down the appropriate keys and allowing the motor to turn the machine over as many times as the item is to be repeated. He is never thrown off the key-board for there is no forcible return of the keys.

This part of the machine is also provided with another vertically sliding control plate 57 which overlies plate 54 and in Fig. 3 largely conceals 54, and which comes into use when a total is to be taken by sliding upward to force its upper end 57′ against

roller 48 pushing that roller backward and withdrawing the zero stop. This vertical movement is controlled through an angle plate 58 at the lower end of plate 57, and the up and down movements of the plate 58 are controlled by the total taking mechanism as hereinafter set forth. Simultaneously with the upward movement of plate 57 to withdraw the zero stop to take a total, the rock shaft 26 swings as previously described to bring its blade 27 into engagement with lug 28 thereby sliding the releasing plate 20 and thereby sliding all of the saddles and stirrups rearwardly and withdrawing all of the stop-wires and leaving the stop nose free from danger of interference through manipulation of the keyboard. The nose is free to swing through its full arc of travel and this is necessary in order that the swing may correspond with the setting of the accumulator wheels.

In some machines it is considered necessary to lock the key-board when a total is to be taken so as to prevent the operator from interfering with the total, either intentionally or through accident. Such locking mechanisms are necessarily delicate and somewhat uncertain in operation. In this machine, on the contrary the keys are not locked during the taking of a total and may be manipulated at will, for because of the effective disconnection between the key-stems and their corresponding stop wires through the sliding movement of the release plate 20 and the resultant backward swing of the stirrups and saddles, none of the manipulations of the keys while taking total will be transferred through to the stop wires. In other words there is an effective disconnection between the keys and the stop-wires, rather than a locking of the keys against movement. This feature is of considerable importance in the construction and practical operation of the machine here illustrated.

As previously mentioned all of the sections of the key-board are readily removable from the machine, each as a separate unit and altogether independently of the others. The others can continue to operate even though several of their companion sections have been withdrawn for inspection or repairs and the sections can be transposed and substituted one for another to equalize the wear on the key-board and to shift into a remote portion of the key-board any section which has given trouble through heavy use or wear. To release any of these sections from the machine, it is only necessary to pull out the key-rod 59 located near the upper rear corner of the section and passing through all the sections and the frame of the machine. It is then possible to pull the section forward and upward out of locking engagement with the transverse cross bars 60, 61 and 62 of the frame from which it normally gets its support. To insure that the machine stands at normal when a section is being taken out, a locking bar 62′ is provided at the lower front corner of the sections, this being part of the main locking mechanism of the machine as hereinafter pointed out.

The accumulator.

(Figs. 2, 8, 17, 18 and 19.)

The accumulator mechanism as a whole includes pinions carrying numbered wheels, a swinging rack for each of these wheels, means for moving each pinion into mesh with its rack as the latter starts movement in one or another direction when the wheel is to be rotated (as when something is being added or subtracted) and for moving it out of mesh at the completion of the stroke. There is also included, mechanism for allowing the rack to slip with respect to the stop-nose by a distance equal to one tooth in either direction so that after one complete revolution of a numbered wheel, the amount so represented can be transferred through to the next adjacent wheel giving that adjacent wheel a movement equal to one tooth. This transferring mechanism also embraces a latch and trigger whereby this slip may be effective to carry over from one wheel to the next in either direction.

There is also provided appropriate mechanism for swinging the segmental racks, for swinging the stop-noses, for shifting the pinions into and out of mesh with their racks and for otherwise controlling the coöperative action of the several parts which go to make up this particular portion of the machine.

Each accumulator pinion 63 (Fig. 17) carries a numeral wheel 64 and is pivotally mounted at the end of a suitable supporting arm 65 rigidly attached to a rock shaft 66. When the pinion is in its uppermost position it is locked against accidental movement by a retaining tooth 67, formed on a bar 67′ spanning the side frames of the machine, but when in its lowermost position it meshes with a segmental rack 68 mounted for frictional drive from the main rock shaft 69 of the machine as hereinafter described. Also frictionally driven from this main rock shaft 69 and in the same friction unit as is the rack 68, is an arm 70 carrying the stop nose SN, it being understood that this arm can swing down between the stop-wire guide plates 52 until it strikes one of the stop-wires 18 and that its swinging movement will govern the swing of the segmental rack 68 except however, that the segmental rack may slip one tooth backward or forward with respect to the stop nose and so can be made to carry

across from one accumulator wheel to another. The stop nose arms 70 have rack teeth thereon for a purpose to be described.

The mechanism whereby the slip between the segmental rack and its stop nose is effected, comprises a pivotal latch 71 carried by the stop nose arm 70 and notched to engage with a projecting lug 72 carried by the segmental rack 68 and projecting outwardly from the side thereof this being the rack which meshes with the accumulator pinion 63. The latch 71 is controlled by a pull wire 73 pivoted to a swinging lever 74 which is pivoted at 75 and has its upper corner 76 positioned to strike against and to be controlled by the laterally projecting lug 77 of the trigger 78 pivoted at 79 and having at its outer end a roller 80 which at proper times can be pushed down to lift stop 77 from in front of corner 76, thereby, through the action of the coiled spring 81, allowing the lever 74 to pull on wire 73 and swing latch 71 away from lug 72, thereby permitting the rack to move with respect to stop nose (or vice versa) by a distance equal to the pitch. The trigger lever 78 is tripped by a cam 80′ rigidly mounted to turn with the next adjacent pinion 63 and numeral wheel 64. It is of circular outline but with a projecting corner so positioned as to strike against the trigger roller 80 of the section next adjacent while the pinion 63 and its numeral wheel 64 are revolving from the "9" position to the "0" position or vice versa. This is the point at which the wheel has fulfilled its function as an accumulator and must transfer or carry over to the next adjacent wheel.

In explanation of this mechanism I may anticipate what will be more fully described hereinafter, and say that when subtraction is to be performed all the accumulator pinions 63 go into mesh with the racks 68 at the beginning of the down stroke of the racks and stop noses; when addition is to be performed, they go into mesh at the beginning of the up or return stroke. Now assuming subtraction is being performed; the stop noses each go down until they strike a stop wire. If a transfer is to take place, that is, when any numeral wheel 64 is turning from the "9" to the "0" position, its cam 80′ will cause latch 71 to be depressed in the next adjacent section which will allow that rack 68 to move past stop nose 70 until lug 72 impinges the lower end of the slot in member 70, or a distance corresponding to one tooth. This movement of rack 68 relative to stop nose 70 is rendered possible by the slip joint connection between the two, both of these members being urged downwardly by the shaft 69 upon which they are each frictionally mounted. Thus the accumulator or pinion next to the one turning from "9" to "0", is turned back one tooth. When addition is being performed precisely the same operation takes place, except that it occurs on the backward movement of the stop nose 70. When the stop nose at the end of its backward sweep is stopped by the bar 60 the rack 68 (provided latch 71 has been tripped) moves on under the frictional impulse of the shaft 69 until the upper lug 72 comes into contact with the extremity of its slot, thus moving the corresponding accumulator wheel forward a distance of one tooth with respect to its stop nose.

As a means for resetting the trigger 78 and the trigger controlled lever 74, there is provided a shaft 82 operated as hereinafter described carrying a lantern construction which extends across from one side of the machine to the other, this construction embodying rolls 83 and 84 the latter of which performs the function of swinging the lever 74 against the tension of its holding spring 81 when the parts are to be re-set. Lever 74 has a cam projection 85 which swings forward when the lever is tripped and so is in the path of roller 84, which by striking this projection, will swing the lever back into position for latching and in so doing will force the latch 71 forward to engage the lug 72 and to lock the stop nose SN with respect to the segmental rack, provided the latch and lug are in correct relative position.

Because of the slip joint connection between rack 68 and stop nose 70 whenever latch 72 has been released, the completion of the up stroke will always leave stop nose 70 held against bar 60 and rack 68 held by the contact of lug 72 with the upper end of the slot in member 70. Timed just ahead of the action at roller 84, the other roller 83 swings around into contact with a projecting shoulder 85′ of the segmental rack 68 and pushes that rack forward with respect to the stop nose 70 by a distance equal to one tooth so that the lug 72 will lie in the middle of its slot and in position to be caught by latch 71 when that latch is raised. This resetting of the stop nose and rack takes place at the completion of a full stroke of the machine.

The triggers 78 and the levers with which they co-act, together with their respective springs 78′ and 81 are mounted on an L-shaped plate 87 connected by staffs according to what may be designated as "clock construction" and each L-shaped plate with its load of springs and swinging members is a unit in itself, and can be assembled by the assembler's bare hands and then slipped into position from the back of the machine, with its front recessed end embracing the main upper cross bar 60 which is slotted to receive it. These L-shaped plates 87 are positioned to receive and to be secured by the same locking rod 59 which is used to hold the key-board sections in position. The

upper or rear end of plates 87 are shaped to embrace the upper rear transverse frame member 88.

The lantern structure 82 comprises end plates 82′ one of which is shown in Fig. 10 and carrying the rollers 83 and 84; the whole lantern being rotatable on shaft 82. The plate 82′ has an extended rounded corner 82^a to which is pivotally connected the link 82^b the other end of which carries a pin mounted in the curved slot 82^c in the wing extension 82^d on plate 154′ carried by shaft 155. The link 82^b is normally held in its rearmost position by the spring 82^e. A pin 82^f projects forwardly from the side frame of the machine which serves as a stop for the plate 82′ and also engages the hooked end of link 82^b when the link is in forward position. When the machine is at rest with the plate 154′ in rearmost position, the lantern structure assumes the position shown in Fig. 10, wherein the rollers 83 and 84 contact with the lugs 85′ and 85 respectively (Fig. 17). As soon, however, as the forward stroke of plate 154′ begins, link 82^b, under the influence of spring 82^e, follows the plate until its hooked end engages pin 82^f whereupon link 82^b comes to rest while plate 154′ continues. In this position rollers 83 and 84 are off-set with respect to lugs 85 and 85′ and the rearward extension 82^a on the plate 82′ has been swung inwardly. The parts remain in this position until plate 154′ has returned to a position wherein the forward end of the slot 82^c impinges the pin in the end of link 82^b whereupon the hooked end of link 82^b is disengaged from the pin 82^f and the parts are returned to the position shown in Fig. 10, alining racks 68 and 70 and causing latch 71 to engage its lug.

Slip joint drive for type carriers and stop noses.

The slip joint between the main rock shaft 69 and the stop nose arms 70 and the segmental rack arm 68 is of the general construction disclosed and claimed in my copending application Ser. No. 485,724 filed March 25, 1909, though in some details it differs from the construction there shown. The slip joint is made up of a series of spools 89 and collars 90 which have keyways to receive a feather 91 on shaft 69, the arrangement being such that these spools and collars can slide along the shaft but must always turn with it. On one side of each collar is a type-bearing lever 92 running back to the rear end of the machine and carrying the removable type head corresponding with one of the key sections, the other end of that lever constitutes the arm 70 which carries at its front end the stop nose whereby the swing of the segmental rack is regulated. On the other side of that collar is the segmental rack arm 68.

The connection between each collar and its coöperating arms 92 and 68 is effected by means of flanges, one carried by the collar and the other carried by the adjacent spool so that these arms need not come in direct contact with the main rock shaft 69. To insure perfect wearing and perfect surface, each of the swinging arms 92 and 68 is faced on both sides with babbitt disks 92′ and 68′ cast in place and accurately surfaced before the machine is assembled. Small holes may be drilled through the arms so that the cast disk on one face will be intimately connected with the cast disk on the other face. To insure uniform wear and lubrication, the rock shaft 69 is made hollow and provided with an oil feed at one end and with radial ducts leading out to an oil groove at each slip joint.

To insure a constancy in the slip and a uniform tension on the various parts of the slip joint, there is provided at one end of the rock shaft a helical spring 93 which is coiled about the rock shaft and presses directly against the end disk, this pressure being transferred across from one collar or spool to the next, it being understood that the series terminates in a disk 94 permanently pinned to the shaft. This spring 93 is housed in a box 93′ see Fig. 19 and on assembly of the machine is adjusted to proper tension, which never need be changed in normal use.

In Fig. 19 where this slip joint is shown partly in section, the extreme right portion of shaft 69 is shown as carrying an extra hammer-bearing arm 95, this arm being projected forward at 96 beyond shaft 69. This is the type-bearing arm which prints the identifying characters, as for instance when a total is printed or when the number of a railway car is printed, or subtraction taken, etc. The means whereby this character is controlled is described more in detail hereinafter.

Concerning the function and advantages of the rock shaft 69 and its operation with the type-bearing arms and with the stop nose arms and swinging rack arms it may be said that it contributes to ease of assembly by allowing substantially all of the parts to be stamped out and made up in duplicate and then slipped on one after the other in their proper order until the entire structure is built up. In normal action the rock shaft 69 swings through a definite angle of rotation every time the machine is turned over, irrespective of the set-up on the keyboard and the stop nose arms 70 swing with it throughout the complete rotation, unless restrained by one of the stop-wires of the key-board or by a stop-guard of the total taking mechanism acting through the swinging segmental rack. These stop-noses do not strike a hard blow on the stop-wires for the slip joint is

so nicely adjusted that while of rugged construction, still the noses always stop when they reach their respective stop-wires. Inasmuch as the shaft continues to turn after the stop-noses hit their appropriate stop-wires there can be no re-bound of the stop-noses, or vibration of any kind during such times as the printing is being done, or in fact at any other time and the action of the noses consists merely in swinging down into gentle contact with their stop-wires and there remaining until the rock shaft begins its return movement. The slip joint for every stop-nose and accumulator rack in the entire machine is held up by a single spring.

The mechanical construction of the slip joint is such that these long metal plates carrying the type at their rear ends are prevented from whipping around or getting out of alinement. It is desirable that the type should be spaced close together and to get this result the type-bearing arms must be staggered over as shown in Fig. 19, but there is no special objection to this in the present machine for the spools and collars press and re-inforce the parts at the joint so that no twisting or whipping is permitted and the type are accurately alined and held in alinement at all times.

Type-bearing heads.

(Figs. 23 and 27.)

At the printing end of each of the printing arms 92 is a removable type-bearing head comprising a pair of side plates 97 and 98 riveted together to form therebetween rectangular chambers in which the printing type 99 are slidingly mounted. Coiled springs 100 are disposed in the spaces between adjacent type and engage with pins 101 projecting from the side of each type, it being the function of these springs to return the type to their retracted position after they have been struck by the hammers. This entire type-bearing head locks into the end of the swinging arm 92 by means of a thin spring metal plate projection 102 coöperating with a pair of headed studs 103 and 104. The stud 104 can be inserted through an opening in arm 92 and stud 103 can then be swung around into the slotted end of that arm and then plate 102 can be snapped over behind a retaining stud 105, thereby locking the type-head on the end of the arm, but in such a way that it can be removed without the use of any tool other than a pen-knife. The type-head bears on its side a thin metal segmental strip 106 projecting outward somewhat beyond the retracted position of the type, but not as far as the striking position of the type, it being a function of this metal plate to serve as a guard preventing the ribbon from becoming caught on the irregular face of the type-bearing head or becoming entangled with a type bar, even though the ribbon be perforated. There is one of these guard plates to each type-bearing head.

The hammer section.

(Figs. 21 to 27.)

The hammer section of the machine comprises a pair of side plates 107 and 107′ connected by cross bars to form a rigid frame wherein the hammers 108 are pivotally mounted on a transverse rod 109 about which they may swing to bring their upper striking ends into engagement with appropriate type after the type-carrying bar 92 has been swung into a position governed by the swing of the corresponding stop-nose.

The striking power of each hammer is controlled by a coiled spring 110, the tension of which may be adjusted through a crank arm 111 carried by shaft 112, the end of which terminates in a crank (Figs. 21 and 24), controlled in position by a nut carried on an adjusting screw 114 arranged at the side of the hammer section and accessible to a screw driver.

Each hammer comprises a finger 115 whereby it is retracted from the type to a striking position, this retraction being effected in two separate steps. The hammer also includes a projecting lug 116 whereby the arm may be prevented from striking in case it is to be held inactive for that particular operation of the machine. To effect this control of the hammers, the mechanism includes a swinging lever 117 pivoted on cross rod 117′ having a notch 118 for the reception of the lug 116 and having a notch 119 for receiving a cross bar 119′ on the lower forked end of a pendulum lever 121, the upper end 121′ of which (except in the case of the outermost lever) normally supports the type-bearing head and is released as soon as that head starts on an upward movement. Lever 117 is cut away at 120 to permit an upward swing far enough to lock lug 116 against stop 118, when occasion may require, as hereinafter explained. In other words, this pendulum lever is held in normal position by the weight of the type-bearing head, and can swing from that position only when released by the head. A coiled spring 122 pulls up on lever 117 and pulls down on a projection of lever 121 in such a way that it tends to swing the lower end of the pendulum lever forward toward the pivotal point of lever 117. The extreme rear end of lever 117 engages with a control bar 123 carried by an arm 124 actuated from a rock shaft 125. Also there is provided a rotating X bar 126, the function of which is to raise the hammers in position for striking and to drop them at the proper instant and then, almost immediately, to

retract them out of contact with the rear of the type so that the type-bearing arm may be free to swing into another position.

It is not necessary here to explain how the X bar 126 is rotated, a detailed explanation of that appearing later, but it is here pertinent to describe the means for swinging the rock shaft 125 to control the position of bar 123 and its coöperating lever 117. The driving connection for this is located on the outside of the hammer section and appears in Fig. 21. It comprises a crank arm 127 rigidly secured to rock shaft 125 and bearing against the outer edge of a cam disk 128 mounted to turn with the X bar 126 and having its edges provided with four notches, each comprising two parts of different depth. With the elements in normal position, as shown in Fig. 21, the crank arm 127 rests in the deepest of these two portions.

The lever 121 never rests against the shoulder nearest recess 120, but is suspended above it free to move over as soon as the type-heads are lifted. The part is cut away at 120 to permit lever 117 to move up when lug 116 is to be caught by stop 118. There is clearance enough for the pendulum lever to swing and it is only prevented from swinging by the weight of the type-heads.

When a type-bearing head starts upward in accordance with a setting of the keyboard, it frees the upper end of pendulum lever 121, leaving its lower forked end free to move over until the edge of the notch 119 is against stop 119′. The several parts remain undisturbed in this position with the pendulum resting against stop 119 until about two-thirds of the full forward stroke of the machine and then X bar 126 and its cam disk 128 turn slowly, shifting crank 127 and so lifting bar 123 to release lever 117.

On further rotation of the X bar 126 the hammer is swung back to striking position while simultaneously swinging lug 116 forward into position for locking with the notch 118 unless lever 117 is being held down by the lower end of pendulum lever 121, as it will be held down if that pendulum has been allowed to swing because of upward movement of its type head. Each type head controls its own hammer and unless the type-head moves up, the hammer will be caught by its lug 116 and will not strike against the type when released through further rotation of the X bar 126. The timing of the rotating bar 126 and the movable rod 123 is such that first the pendulum lever is released and swings forward against stop 119, then rod 123 lifts, allowing lever 117 to come up as far as is permitted by the pendulum lever 121. With that lever 121 in its forward or acting position complete upward movement of lever 117 is impossible and the hammers are free to swing back and strike, wholly under the action of the rotating X bar 126. Bar 126 by its rotation lifts the hammers forward and drops them back with a striking blow. Almost immediately, however, it lifts them away from the type again so that the type heads can swing back into contact with the upper end 121′ of pendulum lever 121, which is thereupon swung back to normal position as shown in the drawing. The second lifting of the hammer is delayed just long enough to permit the transfer plungers to carry across the entire printing section.

In the special case where the hammer is not to print a zero or anything else, the type head will not lift from the pendulum lever and the lower end 121 of that lever will not limit the upward swing of lever 117 with the result that when the hammer is drawn back by the X bar 126, its release will carry it no further than until lug 116 strikes against the stop 118. Nothing will be printed on the paper.

However, there is the special case that in printing numerals followed by ciphers it is necessary to print in the cipher without an upward swing of the type-carrying head and this special case is taken care of by means of transfer mechanism including a sliding plunger 129 for each hammer, movable in a suitable guide-way and having its lower looped end 130, offset as shown in Fig. 24 and shaped to embrace the end of a lever 117 and to engage the upper edge thereof for driving that lever downward when occasion requires. The upper end of plunger 129 is in position to be struck by the tail 115 of the hammer member, and it is this blow transferred across to the next adjacent lever 117 which unlatches the adjacent hammer and allows it to strike the zero type of its section. This unlatching is automatically transferred across from one hammer to the next on the right and so includes in the printing, all of the necessary ciphers.

Control mechanism for adding and subtracting.

Figs. 8, 11 and 12 indicate somewhat diagrammatically the various elements that go to make up the control mechanism, which determines whether the machine shall add or subtract when a certain number has been set up on the key-board. This mechanism includes the hand lever L pivoted to the machine frame, which, in its rearward position, as shown in Fig. 11, is in the adding position, but which can be swung forward into the subtracting position, as previously explained in connection with Fig. 1. When tilted backward as shown in Fig. 11, a roller 131 on lever L passes down over the

lower lip of the recessed end of a rock lever 132 on shaft 189 and swings that lever upward at its rear end, thereby pushing upward on a link 133, the upper end of which carries a roller 134 movable in the slot of a plate 135, to which is riveted the plate 135′. The construction is to permit the roller 134, which has a flange on the inner side of slotted member 135 to pass the pivot of this member. Plate 135 has a projecting arm 137 at its rear end, having a cam slot to receive a roller 138 carried on the lower end of a swinging arm 139, this arm being rigid on the rock shaft 66 and serving to control the inward and outward swings of the supporting arms 65 which carry the accumulator pinions 63, the numeral wheels 64, the stop cams 80′ and the totaling stops 80^a.

Pivotally connected with the stud of the roller 134 and with the upper end of link 133 is another link 140 pivoted to the upper end of a plate 141 pivoted on a stub-shaft 142 and having a roller 143 at its lower end and an offset retaining lug 144 at its rear edge. An auxiliary plate 145 is pivotally mounted on the stub shaft 142 and can swing with respect to plate 141 and is used to put that plate under tension at each forward or backward swing of the machine so that the numeral wheels 63 will snap into or out of mesh, as the case may be, at appropriate times. To effect this result there is interposed between plate 145 and plate 141 a spring 146 which is coiled about shaft 142 and has both of its ends projecting upward divergently, these ends being respectively anchored in guide plates 147 and 148, both of which are free to swing about shaft 142 and serve merely to hold the ends of the spring to their work. With the elements in the position shown in Figs. 11 and 12 the spring-supported guide plate 147 will contact with a stud 150 on the upper end of lever 141 and the other spring holding plate 148 will contact with a stop 151 projecting from the top of the swinging plate 145, thereby putting the two parts under tension and tending to swing the stud 150 toward the stop 151.

Referring now to Fig. 8, it will be seen that the means for swinging plate 145 consist of a pair of studs 152 and 153 mounted on the outer face of the main controlling plate 154. This controlling plate is driven in a manner hereinafter described and turns on a shaft 155 forward and back at each swing of the machine. The upper edge of plate 154 has a laterally projecting flange 156 which serves as a retaining cam for holding roller 143 against movement until the machine has reached just the proper point in its swing and thereupon releases that roller to allow plate 141 to snap over in response to the tension which in the meantime has been put on it through spring 146, for this spring meantime has been loaded by the swinging motion induced in plate 145 through engagement therewith of one or the other of studs 152 and 153. In other words the studs on plate 154 swing lever 145 backward and forward at every operation of the machine, thereby shifting the spring tension from one side to the other with respect to plate 141 and it is the function of the roller 143 to prevent the parts from slipping through until the machine is in exact position and this exact position is defined by the release of roller 143, by the controlling flange 156 projecting laterally from the upper edge of plate 154. The object of this mechanism is to shift the accumulator pinions 63 into and out of mesh with racks 68 at the proper instant.

Referring to Fig. 11: This figure illustrates the position of the parts before wheel 154 has begun its forward stroke and when the lever L is in its rearward or adding position. In this position of parts roller 134 is at the top of the slot in plate 135. The forward stroke of the wheel 154 will operate to first lock roller 143 by means of flange 156 and then to swing the lower end of lever 145 by impact thereupon of a pin 153. The upper lug 151 on lever 145 will move the swinging arm 148 to the right and tension spring 146 without, however, shifting pin 150, for the reason that plate 141 is locked. As soon, however, as the flange 156 has passed off roller 143 plate 141 is free to rock and under the tension of spring 146, applied through member 147 will be swung to the right. This will communicate a forward impulse to link 140, rocking the slotted plate 135 in a clockwise direction, which lowers arm 137 and by means of the caterpillar slot therein rocks lever 139 and causes accumulator pinion 63 to go into mesh with rack 68. The return of wheel 154 will first lock roller 143 in its new position, thus holding accumulator pinion 63 in mesh with rack 68 and thereafter pin 152 will impinge lever 142 putting tension on spring 146 in the opposite direction, so that at the end of the return stroke when roller 143 is released by flange 156, spring 146, acting this time through arm 148 will cause a rearward impulse to be communicated to link 140, thus rocking slotted plate 135 in a counter clockwise direction, which, through the caterpillar slot in this member will swing arm 139 to the left and withdraw accumulator pinion 63 from mesh with rack 68. This is the position of the part illustrated in Fig. 11. Thus, while the machine is adding the accumulator pinions are held out of mesh on the forward stroke put into mesh during the rearward stroke and automatically flipped out of mesh at the end of the rearward stroke.

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The subtracting operation is analogous. In subtracting, the level L is in its forward position wherein lever 132 is tilted downwardly at its rear end, causing roller 134 to engage at the lower extremity of the slot in plate 135. Precisely the same operation of the remaining parts will cause the accumulator pinion 63 to be held in mesh on the forward stroke, thrown out of mesh at the beginning of the rearward stroke, and flipped into mesh again at the end of the rearward stroke. This must be true because the operation of all the other parts being precisely the same in either case, in the subtracting operation link 140 (being lowered) communicates an impulse to the opposite end of pivoted plate 135 rocking this member in precisely the opposite direction each time to the direction it would rock it at the same stage of operation if adding were being performed.

There is an auxiliary plate 157 (Fig. 8) pivoted on a sub-shaft 158 and having a laterally projecting stop 159, which will ride on the top edge of the large rock lever 132 when that lever has been tilted upward at its rear end for the adding position. But in case of subtraction, and with this lever 132 tilted down out of the way, this auxiliary plate 157 swings forward at its lower end under the driving action of a coiled spring 160 so that the notch 161 near its lower end may engage with the laterally projecting stop 144 located on the rear corner of the swinging plate 141. The result is that when lever 132 is set for subtraction, the projection 144 will snap in under the shoulder at 161 as soon as it is released at the end of the forward stroke, this having the effect of positively keeping the numeral wheels out of mesh with the segmental racks (on the return stroke) until other operations have taken place, including rotation of the lantern shaft 82 and reengagement of latches 71 with their lugs 72 to again connect each segmental rack in its normal relation to its stop nose arm. The swinging plate 157 continues to lock plate 141 against return movement until the main plate 154 swings back far enough to bring a lug 162 against the lower offset end of plate 157, and thereupon that plate is unlatched and plate 141 can swing back under the driving impulse of its spring 146, which has long previously been shifted over to put the tension on in the other direction.

From the foregoing it will be apparent that with lever L in the adding position, the accumulator pinions are out of mesh at the beginning of the forward stroke and are flipped into mesh at the beginning of the rearward stroke while for subtraction they are put into mesh at the beginning of the forward stroke, flipped out at the beginning of the rearward stroke and positively held out until the beginning of the forward stroke.

With this machine there is the advantage that after each subtraction, the calculator wheels are again shifted into mesh at the conclusion of each turn over of the machine and so are in position for a second subtraction.

To deaden or cushion the swing of lever 137 its rear end is positioned to engage with shoulders on a sliding plate 137′ (Fig. 9) movable up and down and frictionally retarded by a spring metal retaining plate 137″ having crimped ends engaged in the recessed ends of studs 137‴ upon which plate 137′ is slidably mounted.

The peculiar motion induced by roller 131 on lever L in lever 132 constitutes an important feature of my invention. The action of the lever L on lever 132 is positive at its extremities, yet in its intermediate positions it has all the freedom of a slot and pin connection. It is an important advantage to have adding lever L first lock the machine, when it begins to swing and at the extremity of its swing unlock the machine, substantially the entire swing of lever 132 taking place while the machine is locked. To bring about this I have formed lever 132 with two lips 131^a and 131^b and a central aperture therebetween. In operation and supposing the parts to be in the position illustrated in Fig. 11, wherein the adding lever is in its rearward position and the forward end of lever 132 down, it will be apparent that the adding lever may swing until roller 131 has cleared the lip 131^a and passed the open space in the center and actually come into contact with lip 131^b before the lever 132 is shifted. The first part of this movement of lever L serves to lock the machine. After striking lip 131^b roller 131 first gives lever 132 a quick short swing to set it to its upper or substracting position; this comes about before roller 131 can continue in its movement. After lever 132 has been thus quickly shifted to its upper position, roller 131 can then continue to ride up lip 131^b without having any effect on lever 132. It is this part of the movement which serves to unlock the machine. The rock mechanism for the adding and subtracting lever comprises a swinging plate 185 to which is rigidly connected the plate 267 and having a rearward corner thereon adapted to swing across the path of block 186 on plate 154 effectually locking the machine.

Totaling mechanism.

(Figs. 2, 3, 8, and 10.)

The total taking mechanism includes the total lever TL pivotally mounted on a rock shaft 163 and connected with the adding and

subtracting lever L by means of a link 164 which is pivoted to the total lever and which is connected to the adding lever by a slot and pin connection 164′ when the total lever TL is in its rearward position. Lever L can be swung either forward or backward without disturbing the total lever TL but if the total lever is swung downward it necessarily takes with it the lever L, thereby setting the mechanism in subtracting position, it being understood that in this machine the totaling operation is a partial subtracting operation and includes unreeling or backing out of the calculator wheels, the total of the items previously put in. The total lever TL is slotted at 165 for engagement with the end of the link 166, the other end of which is pivoted to a rocking cam plate 167, the cam way of which engages a roller 168 carried on the lower end of the crank arm 169 rigidly mounted on a rock shaft 170. Rock shaft 170 carries hooks 171 (Fig. 10), the rearward ends of which serve as stops, and positioned to be swung around into abutting relation with the lugs 80^a one of which is carried on the shaft with each calculator wheel 63 and its numeral wheel 64. The lugs 80^a occupy a space of one pitch of the gear pinion, and the parts are so arranged that when the hooks 171 are thrown rearwardly lugs 80^a will bring numeral wheels 63 to rest in correct position to drop into mesh with rack 68. When a total is to be taken since the lever L is thrown forward, as above described, all the numeral pinions 63 will go into mesh with rack 68 at the beginning of the forward stroke (as for a subtraction) pinions 63 will then revolve backward until lugs 80^a strike hooks 171. This position corresponds to the zero position of the accumulator wheels. Since the number in each accumulator wheel has been rolled out, the racks are set at whatever number was registered on the wheels before the operation began. If the numeral wheel should register zero at the beginning of the operation, its lug 80^a would, of course, already be in contact with the corresponding hook 171 and that rack would not be permitted to start. Thus the total will be backed out of the machine, and at the same time the racks 68 set in position to correspond with the amount of the total and the total printed as the machine is cleared. The accumulator pinions are raised out of mesh on the return stroke of racks 68, so that the completion of the operation will find the total printed and the machine clear.

As a part of the total taking mechanism there is provided a slot 172 in the total lever plate TL and riding in that slot is a roller on the end of an arm 173 revolubly mounted on a rock shaft 174 from which shaft a rigidly mounted arm 175 extends rearwardly as shown in Fig. 2 and supports the angle bar 58, whereby, through the action of the vertical plate 57, the zero stop is withdrawn whenever a total or sub-total is to be taken and printed. The arm 173 has a lug 173^a thereon, which engages the lug 174^b on crank arm 174^a on shaft 174 when the arm 173 is moved in a counterclockwise direction, as viewed in Fig. 8, and coiled spring 174^c acting on shaft 174 normally keeps the arm 175 lowered.

The total taking mechanism also includes a swinging arm 176 having its front face shaped to engage with a stud 177 projecting from the outer face of the total lever TL, it being the function of this arm to swing on a stud 176′, and induce a swinging movement in the downwardly extending arm 178 which is off-set with respect to arm 176 but must move therewith. The lower end of this arm 178 is slotted and cammed to engage a roller 179 acting through a crank 180 to swing the rock shaft 26 (Fig. 3) whereby the blade 27 is swung upward against lugs 28 and shifts the releasing plate 20 to withdraw all of the stop-wires so that the stop-noses will not be interfered with by any of the key-board mechanism, but will be free to swing in response to the setting of the numeral wheels, or in other words until the stopping of those wheels by engagement of hooks 171 with stops 80^a.

While the operator is swinging the total lever from its normal position to its active position, it is desirable that the machine be locked against rotation, and to effect this result, there is provided on the lower edge of the total lever plate TL a cam 181 which rolls over a roller 181′ carried on a bell crank 182 working against the tension of a spring 183 and serving to swing the lower arm of that bell crank against a roller 184 projecting from the side of the stop-plate 185. When the operator starts to swing the total lever back, the cam 181 rides up on the roller 181′ and swings plate 185 downward into the path of a stop-plate 186 carried on the side of the main control plate 154, which acts as a brake thereby locking the machine against rotation until after the total lever has reached substantially its forward or working position and thereby has swung its cam 181 beyond the roller of plate 182 far enough to permit the locking plate 185 to move upward again to the clear position.

The lower edge of the total lever plate is cut away at 187 so that the shoulders thus formed can act in conjunction with shaft 189 (which carries lever 132) to limit the swing of the total lever.

The sub-total lever STL is of the shape shown in Fig. 14 and has its lower edge

provided with a cam face 190 so that it can also serve to swing the bell crank 182 and force the locking plate 185 into position in front of the main control plate. But this projection 190 on the sub-total lever has an additional function, in that it may swing forward to lie over an arm 191 projecting forwardly from the swinging plate 141; thereby acting to prevent that plate from swinging, irrespective of a shift in the tension device. The result is that in taking a sub-total, the numeral wheels are thrown into mesh with the segmental racks and run along until stopped, but are not lifted out of mesh on the return stroke. They must run back over the same distance and thereby take up again the total which they had just given up to the printing mechanism. In other words this projection 190, coöperating with the arm 191 insures the retention in the calculator of the total, which has been printed out, in this respect differing from the operation when the total lever TL only is depressed, for in that case the total is printed out and the machine is cleared.

The sub-total lever is connected with the total lever TL through a stud 193 which strikes against an inwardly projecting extension of stud 177, so that although the total lever can be pulled forward without disturbing the sub-total lever, it is not possible to pull the sub-total lever without also swinging the total lever with it. It is this forward swinging of the total lever that sets all of the various total taking mechanism and it is the forward swing of the sub-total lever that so locks the swinging plate 141 as to insure return of the total into the calculating wheels.

The repeater control.

(Figs. 3 and 8.)

To insure repetition in the machine, as repeated additions, or subtractions, or printing, without setting up the key-board each time, there is provided at the front of the machine the repeat lever RL pivoted on a short shaft 194 and limited as to length of swing by a stud 195 running in a slot. The lower corner 196 of this rock lever plate carries a roller running on the cammed face of an irregularly shaped plate 197 pivoted at 198 and having its rear end provided with a laterally projecting flange 199, the function of which is to drop down against the forward end of bar 200 and force that bar down against the tension of its spring 201, thereby unlatching it from a pin 202 carried by a crank 203 mounted on a rock shaft 23 which, as is shown in Fig. 3 has the function of shifting the release plate to return the key-stems and stop-wires to normal.

With this rock shaft 23 thus rendered inactive the original key settings will remain undisturbed and the machine may continue to operate any number of times, repeatedly adding or subtracting and printing that set-up, without clearing the key-board. On return of the rock lever 197 to its inactive position, as shown in Fig. 8 the bar 200 will again swing up into driving relation with pin 202 and the keyboard will be cleared at each swing of the machine.

In order that the machine may be locked while the repeating lever is being shifted from its up position to its down position and likewise to prevent any operation of the machine when the repeat lever is not exactly in one or the other of those positions, there is provided in the lower edge of that lever, a pair of notches separated by a cam face 204, the function of which is to force downward on the end of the bell crank lever 205 pivoted on a shaft 206 and having its lower rear end connected through a link 207 with the forward end of the locking plate 185, whereby the main plate 154 may be locked against rotation. With the repeat lever in the upward position, as shown in Fig. 8, the rollered end of lever 205 lies in a recess and the machine is not locked and similarly when the repeat lever is in the downward position, the roller lies in the depression on the other side of the cam face 204 and the machine is not locked but at any intermediate position the bell crank 205 is out of normal and the locking plate 185 projects down into the path of plate 186. The locking bar 62′ for the key-board sections (Figs. 3 and 19) is carried by the levers 205 and when depressed also serves to lock the machine against rotation.

Eliminating numbers from the calculator.

(Figs. 8–13.)

In order that we may print various numbers on the record, as for instance box car numbers, and not add them in at the accumulator, there is provided an eliminating lever EL at the front of the machine, the function of which will now be described.

This lever normally stands down, as shown in Fig. 8. It is pivotally mounted on stud 194 and has its lower edge notched to receive the roller of plate 205 so that it fulfils the function of locking the machine against rotation when this lever is not at its upper or lower limit, in this respect corresponding in action with the repeat lever RL. The essential part for securing the printing of a number without its addition or subtraction at the calculators, consists of a roller or pin 208 which rolls around against the forward edge of a rocking arm 209, the upper end of which is pivotally attached to a long push bar 210 the rear end of which is

pivotally attached at 211 with the upper end of a swinging plate 212, Fig. 13, the lower end of which carries a hook 213, the function of which is to lock the stop 144 of plate 141 against downward movement. The function of this hook is to prevent any movement of the plate 141, irrespective of the shifting of its tension device, thereby preventing any swing of the arm supporting the calculator wheels and positively holding the calculator wheels against their retaining pins 67.

Also connected at the pivotal point 211 at the upper end of this plate is a push bar 214 which extends rearwardly and upwardly, its outer end being supported and guided by a stud 215 which is received in a slot in that bar. This bar 214 is cut away to lie over the shaft 82 of the lantern structure (which is used to shift the segmental racks with respect to their stop noses and to drop the latches in for holding these two parts in their proper normal relation).

Bar 214 carries a shoulder 216 which, when the bar is thrust backward comes into locking engagement with a pin 217 carried by shaft 82 and so holds the lantern structure against rotation. It is to be remembered that the lantern structure is not positively rotated, but is merely released from its normal position, swinging through a limited arc by a spring (Fig. 10) and reset by a slot and pin drive from shaft 155. Shoulder 216 acts as a detent to prevent the release of the lantern structure when the eliminating lever is up. In a certain sense the part 214 is superfluous, being in the nature of a duplication of the operation and function of the hook which holds stop 144 and the machine can be operated without this additional safeguard.

When the eliminating lever is up in its active position, the swinging arm 209 has a lug on its rear edge forced in under a stop shoulder 218 formed in the front edge of the adding and subtracting lever plate. The result being that this plate is locked in the adding position, this being the position in which the numeral wheels are out of mesh with their segmental racks and also the position in which the total lever and the subtotal lever are locked in their normal position by the cross link 164. In other words, it is not possible to disturb the normal setting of either of the total levers while the eliminating lever is in its upper or operative position. A total in the machine is thus protected and cannot be changed or eliminated.

It will be seen that the adding and subtracting lever L works through a bell crank 219 pivoted on shaft 176′ to move a link 220 rearwardly, this link being pivoted at 184 to plate 185 and serving to force that plate down into the path of the plate 186 to lock the machine while the adding and subtracting lever is being shifted, so that the machine is locked when either the adding lever or the total lever, or the repeat lever or the eliminating lever is being shifted. All of these locking mechanisms work through the downwardly extending arm 267 of plate 185 to control the effective connections between the motor and the machine, as hereinafter explained. Thus the machine is locked whenever any control is being shifted.

Printing special characters.

Referring to Fig. 9, an explanation may now be made of the means used to control the printing characters such as the minus sign, the total sign, etc. As previously explained in connection with the printing mechanism, these characters are arranged in a row on a swinging type-bearing head just as if they were numbers and that type-bearing head is carried on an arm which is driven through a slip joint from the main rock shaft 69 of the machine.

As the parts appear in Fig. 9, this character arm C, appears at the extreme left of the figure and its coöperating stop nose lever SN projects forward toward the front of the machine where it is in position for coöperating with a large sliding plate 221 having a series of notches 222, any one of which may serve as a stop for the stop-nose, provided plate 221 is drawn forward far enough. This plate 221 is connected up with the eliminating lever EL and with the subtracting lever L and with the total lever TL and with the sub-total lever STL, so that by operation of any one of these, the plate will be moved over far enough to allow some movement of the stop nose SN. Movement of the eliminating lever will shift plate 221 so that the stop-nose will enter as far as the first notch, operation of the subtracting lever will shift the plate to bring the stop-nose into the second notch, operation of the total lever will put it in the third notch and operation of the sub-total lever will put it in the fourth notch. The connections between the eliminating lever and sliding plate 221 comprise a roller 223 secured near the lower edge of plate 221 and movable by means of a bell crank 224 pivoted to a suitable support and having its upper end engaging with a lug 225 carried on the side of the long link 210, the rearward movement of which is effected when the eliminating lever EL is swung upward into active position.

The connection between the adding and subtracting lever L and the sliding plate 221 is brought about through the swinging movement of the long rock lever 132, for that rock lever carries at its lower edge, somewhat in front of its point of pivotal support, a downwardly extending cam face 226, which on the upward swing of the front

end of that lever presses against a roller 227 carried on the lower end of a slide plate 228 bolted to the inner face of the slide plate 221. This movement is sufficient to shift the plate over two of the notches at the stop-nose. When the total lever TL is swung forward to take and print a total and clear the machine, it exerts a forward push on a stop 229, positioned at the upper edge of plate 221. This result is obtained through the action of an irregularly shaped plate 230 pivoted at 231 to the total lever and having its lower slotted end fitted over a pin 232 projecting from the side of the sub-total lever. Then as the total lever is swung forward without movement of the sub-total lever, this plate 230 will rock on its pivot and will also swing forward, the result being a forward push on the stop 229 by the upper face 230′ of the plate 230, moving plate 221 a distance equal to three of the notches for the stop-nose. But if it happens that the sub-total lever be swung forward simultaneously with the total lever as when the machine is to print its total and retain the total in the calculating wheels, then as the forward movement of the sub-total lever swings pin 232 forward, the total lever goes with it, plate 230 does not rock and strikes lug 229 with its end 230″ moving plate 221 back a distance of four notches.

The slide plate 221 may be held in place in simple manner, as by means of a button 233 riveted to a frame plate 234, the lower edge of plate 221 being held behind the head of a stud 235 and the front end being held and guided by the head of a stud 236. To dismember the machine, the plate may be drawn forward and slipped off over the head of stud 236.

The frame plate 234 is of irregular outline, as shown in Fig. 9 but fits in over the transverse frame bars 60, 61 and 62 and is removable therefrom in much the same way as the key-board sections. The retractive movement of plate 221 is effected by a coiled spring 237, which has one end fastened to the frame plate 234 and the other fastened to the side plate 228, which is riveted to the sliding plate 221. This spring draws the plate back into normal position, as soon as that plate is released by appropriate movements of the eliminating lever or the adding lever or the totaling levers.

Controlling the zero stops.

This same figure also illustrates the mechanism used for controlling the zero stops in the key-sections. This mechanism comprises a plate 238 pivotally mounted at 239 and having feet 240 and 241 to act as stops in limiting the upward or downward swing of each end of the plate by striking against cross bar 174. Beyond the key-board section on the other side of the machine is a similar plate 238′ and these two plates serve as supports for the cross bars 56 and 37. Cross bar 56, which is carried at the rear ends of plates 238 and 238′ operates as indicated in Fig. 3 to drop plate 54 and disconnect the zero stop from the key-board immediately after the stop nose has struck that stop or has passed it, thereby preventing a delayed release of the stop nose in case a key is depressed during the forward swing of the machine and later, after the backward swing is nearly completed, it serves to lift the vertical plate 54 and to withdraw the zero stop. This is useful in those special cases where a key has been depressed during the backward swing and before the machine has returned completely to normal, thus holding the zero stop back so that the forward swing can be begun immediately. If no key has been depressed on the backward swing, the upward movement of bar 56 will reset the zero pin and reconnect it through link 47 with the key-board so that subsequent depression of a key may withdraw it.

It is the function of the cross bar 37, as shown in Fig. 3, to lift up on the rocking links 34 and thereby disconnect the correction keys CK from the releasing plates 20 while the machine is turning over.

The rear end of this rocking plate 238 is normally pulled downward by a coiled spring 241′ and the downward swing is controlled by a stud 242 projecting from the side of the disk 243 mounted on the main drive shaft 155, so that as this disk 243 begins its forward swing, the stud 242 drops away from plate 238 and allows the cross bar 56 to drop and these parts remain in that condition until the return swing of the plate, when the stud 242 again lifts the adjacent end of the rock plate 238. This lowers and raises the sliding link 54 to control the zero stop in the manner and for the purpose heretofore explained.

Driving the printing mechanism.

(Figs. 9, 21 to 24.)

The means used for driving the printing mechanism from the main power shaft comprises a pair of pushers 245 and 246 pivotally mounted along the lower edge of the disk 243 and guided at their rear ends in a supporting structure 246′ in such a way, that pusher 246 may engage one pin of a rotary lantern 246 and pusher 245 can engage the next pin. As the result of their coöperative action, pusher 246 gives a slight turning movement to the lantern and then reaches the dead center point with respect to shaft 155 and so remains practically stationary while pusher 245 is coming up to give a quick thrust to the next pin of the lantern. These two pushers thereby give an intermittent movement to the printing X bar of the printing mechanism and bring about

the alternate release and positive retraction of the hammers of the printing mechanism.

The motor drive.

(Figs. 8, 42 to 45.)

The motor drive for the particular embodiment disclosed in the present drawings, includes an electric motor 247 having its armature shaft connected through a worm 248 and worm gear 249 inclosed in a cup-shaped housing 250 bolted to a supporting plate 251, which is carried by a casting 252 depending from the base 1 of the machine.

The worm wheel 249 is keyed to a tube 253 and serves to turn that tube in the bearings of castings 250 and 251. One end of that tube carries a ratchet 254, which turns continuously so long as the motor runs. This ratchet serves as the driving element for the machine, the driving connection being established through the aid of a pawl 255 which can be released to catch into the ratchet wheel 254 and hold on until the pawl and all the parts connected with it have swung around through one complete revolution and have come back to their starting point. The pawl is made to grab into the ratchet 254 by means of a swinging lever 256 pivoted at 257 and having its upper end connected by a link 258 with the lower end 259 of a rock lever pivoted at 260 and having its forward arm 261 pivotally connected with one of the push rods 262 of the tripping rail R. The other push rod 263 of the tripping rail is connected through a bell crank 264 and through a link 265 with the lower end of the rock lever 259, thereby equalizing the action of the tripping rail. The rearwardly extending arm 266 of the rock lever pivoted at 260 reaches through into the machine (Fig. 8) in position to serve as a lock for the downwardly extending arm 267 of the swinging plate 185, the result being that after the tripping rail R has been pushed, the locking plate 185 cannot swing downward to check the forward swing of the machine and similarly if plate 185 has been swung to check the machine (as through incomplete shifting of any of the hand levers at the top of the key-board) it will be impossible to operate the tripping rail. In other words either arm 266 or arm 267 can serve as a lock for the other, by swinging across into the path of the other. Each element is thus a safeguard for the other.

Pushing down on the trip rail R swings the lower end of lever 256 out of engagement with a forwardly projecting lug 268 on the crank plate 269 and almost immediately thereafter releases the tail of dog 255 by moving outward beyond the end of it, so that under the action of its spring 270 that dog can catch into the ratchet wheel 254 locking the crank plate 269 to the ratchet and compelling the crank plate to throw over through one complete revolution of the ratchet. The tail of the dog is slightly longer than the tail of plate 269. The crank plate 269 is mounted on a tube 269′ housed within the rotating tube 253. This is just a convenient way of getting a bearing surface for the crank disk support. But inasmuch as the worm gear ordinarily would run continuously in oil, its supporting tube may be perforated to permit entrance of oil between the tubes to give constant lubrication of the crank disk support. Pivoted to the crank plate at a crank pin 271 is a pitman 272 which reaches up into the machine, as shown in Figs. 8 and 42 and there is pivotally connected to the lower end of the main swinging plate 154 of the machine. During this rotary movement of the crank plate, the crank pin 271, which carries a roller 273 swings around and strikes against a curved lever arm 274 swinging that arm rearwardly. The arm is rigidly mounted on a rock shaft 275 which also carries another lever arm 276, having pivotal connection at its rear end with the push bar 200 of Fig. 8, whereby the periodical rocking of shaft 23 is effective at mid-stroke to shift the releasing plate 20 rearwardly and release all the key-stems so that they may return to normal. The arm 276 has a forward projection serving as a stop, by engagement with a stud 277, thereby limiting the swing of shaft 275 and its arms 276. When the crank disk 269 has made one complete revolution, the lever 256 will be in position to act as a stop and will serve, first to unlatch the dog and almost instantly to strike against the projection 268 of the crank plate, thereby checking further movement and holding the crank at its dead center with respect to the load. If the operator holds trip rail R down, the crank disk will continue to rotate and the machine will repeat its operations. A spring pressed latch 278 may be provided for catching the crank to prevent it from slipping back because of any tendency to rebound. This latch has a downwardly extending arm 279 bearing against a stud which serves to limit the upward swing of the latch. The coil spring 278′ serves a double purpose of yieldingly holding up latch 278 and yieldingly holding down arm 266 whereby the tripping rail is held upward and the latch 256 in position to engage with crank plate 269.

With this mode of driving the machine from the motor, the travel is from a dead center back to that same dead center, and as the result, the load comes on the motor gradually and the speed of travel within the calculating machine builds up gradually and the motor is disconnected from the ma-

chine after the calculating parts have been returned to a substantially stationary position, through slowing up of the mechanism as the crank approaches again the original dead center. No cushions or dash pots are required and the connection between the motor and the calculating mechanism is positive and direct. This mode of driving, insures a full stroke of the mechanism, thereby effecting complete return of all parts to normal at each stroke.

The worm drive in addition to driving the ratchet for turning the machine, also has connections for driving the carriage and particularly for shifting the carriage longitudinally with an intermittent motion, so that different groups of figures can be printed in parallel columns on the strip of paper.

The carriage driving mechanism.

(Figs. 46, 44 and 47.)

On the rotating tube 253 at the end opposite from that used to turn the machine over, is a second ratchet 280 which is used to shift the carriage longitudinally. Coöperating with this ratchet is a dog 281 which can be thrown in to grip the ratchet when the shift is to be made. This dog operates in essentially the same way as the dog used for turning the machine over and has a rearwardly projecting tail 282 adjacent to a similar projection from the crank disk 283, these projections being in position for engagement with a hook 284 pivoted to swing from a stub shaft 285 and having an upwardly projecting arm 286 connected through a link 287 with a similar arm 288 carrying another stop 289. For shifting the carriage, the crank disk 283 makes one-half a revolution at each shift, the carriage traveling to the right for a half turn of the crank disk and then coming back to the left for the next half turn of that disk. Spring catches 290 and 291 may be relied on to hold the crank disk at its dead center, thereby preventing it from swinging back because of the weight of the connected parts, or because of any rebound or vibration.

The crank disk 283 is pivotally connected with a pitman 292 which is pivoted to a rock lever 293 carrying a connecting rod 294 working through a bell crank 295 to shift the carriage driving pin 296 back and forth along the line of travel of the carriage. When the carriage is in place, it has a link connecting with this pin 296 and its longitudinal movements are controlled thereby

As a means for governing the action of the dog 281, I make use of a push rod 297 pivoted to the rock lever 293 and carrying a pair of coiled springs 298, 299 adjustable in tension and both bearing against a pin 300 of the swinging arm 286. When the carriage is in one position, spring 298 is compressed and when it is in the other position spring 299 is under compression. With the elements in position, as shown in Figs. 46 and 47 spring 298 is under compression tending to force the hook away from the tail of dog 281 and tending to force stop 289 inward to a striking position, but movement is not possible because of engagement between a little lug 301 on the extreme upper end of arm 286, and a pair of lugs projecting downward at 302, one of which is mounted to swing with a rock lever 303 pivoted at 304 and controlled in its movement by a coiled spring 305, a limit stop 306 and the push rod 307, which rod runs up to the top of the key-board and terminates at its upper end in the carriage-lock wing-piece CL. When CL is down the carriage shifting mechanism is locked at 302 and no shifting can occur, but when it is up, one of the stops at 302 is out of position and movement of the carriage will be governed by the raising and lowering of the other stop. This other stop is carried on a swinging arm 308 pivoted at 304 and controlled by a coiled spring 308′, the free end of this arm carrying a roller 309 which bears against a swinging arm 310 mounted on a rock shaft 311 which goes through to the other side of the machine, as shown in Fig. 8 and which terminates in an upwardly projecting arm 312, the extreme upper end of which is bent over to lie in the path of arm 267, so that at each forward swing of arm 267 (resulting from the downward swing of the locking plate 185) there will be given a slight rotary movement to rock shaft 311 (each time any of the control levers is manipulated) and this slight rotary movement of shaft 311 is sufficient to lift arm 308 and allow stop 301 to swing by to the other side of its coöperating stop at 302, thereby unlatching the dog 281 and connecting in to the motor and so shifting the carriage across to the other side.

In case it is desired to shift the carriage, without changing from additions to subtractions or vice versa, it is only necessary for the operator to lift the control lever L or the totaling lever TL for a small fraction of its complete throw, allowing it to snap back without completing the throw. This has the effect of unlatching the holding means for the carriage pawl and so allows the carriage to be shifted over to the other side, leaving the control mechanism at the key-board in the same setting as before.

In placing debits and credits in separate columns on the printed record, the machine of my invention makes the shift from one column to the other, preparatory to the printing of each item, this action being entirely automatic and calling for no thought on the part of the operator, other than that of seeing that the control levers are set to add or subtract as the items are being put into the machine.

This carriage shifting mechanism is powerful in operation and certain in its action both forward and back and inasmuch as the weight of the carriage to be shifted, may be relatively great, particularly in machines of great capacity and used especially for tabulating, there is afforded ample power for making the shift with the proper speed and with certainty and without overloading the motor or subjecting the calculator to undue disturbance or in any way interfering with the normal use of the motor as the driving means for the calculating mechanism. The carriage shifting mechanism puts on the load at a dead center and takes it off at a dead center, so that as far as concerns the motor, the load comes on and goes off without shock. No cushioning or dash pots are needed.

Over draft mechanism.

The over-draft or limit (Figs. 10, 40 and 41) locking mechanism is used to lock the total mechanism to prevent taking a total when more has been subtracted out of the machine than has been put in, or in other words when the accumulator falls below zero, and this locking mechanism remains effective to prevent total taking until after enough has been added into the machine to bring it back again from beyond its limit onto the working range of the accumulator.

Also the over-draft mechanism, through action on the right hand hammer of the series of hammers prints on the record at the side of each subtracted number, a character showing that the machine is in over-draft position. This character does not appear after amounts added in, and is not necessary as such additions tend to correct the over-draft condition and tend to bring the machine back to its normal working range.

This over-draft mechanism is also so adjusted that after additions have been made sufficiently to build up a total in which the last accumulator wheel is loaded to its capacity, the total taking mechanism will become locked and no total can be taken until the calculator has been returned from this abnormal state.

This over-draft mechanism shown in Figs. 10, 40 and 41, comprises a trigger 320 pivotally mounted at 321 and having its outer free end positioned under the numeral wheels and carrying a platform 322 lying in the path of the cam 323, which in appearance and position is like the cams 80′, but which has a function quite different.

The other end of lever 320 has its upper edge bent over horizontally to form a stop 320′ which normally lies in the path of the upper end 324 of a swinging arm 325 mounted to swing on a frame stud 326 and having its front edge formed into a shoulder at 327 as shown in Figs. 10 and 40 to bear against the lantern structure which swings about shaft 82 as a center.

Unless the last number wheel and its cam 323 is in the "9" position the lever 320 will have its stop 320′ in the path of the upper end 324 of lever 325 and lever 325 cannot swing forward as the lantern structure rotates. But in case of repeated additions until the total has increased so far that the last numeral wheel is in the "9" position, the cam 323 pushes down on platform 322 of lever 320 and unlatches arm 325, allowing that arm to swing forwardly toward the key-board as the plate 82′ comprising one end of the lantern structure is rotated, and by so doing, turn on stud 326. But pivotally mounted on stud 326 and off-set somewhat with respect to lever 325 but swinging therewith, is a downwardly extending arm 328 controlled in its movement by a coiled spring 329 (Fig. 10) and being pivotally connected at its lower end to a link 341, a mere fragment of which appears in Figs. 10 and 40 and the main body of which shows in the drawing of the hammer section, Figs. 22 and 23. It runs rearwardly for connection to a crank arm 342 on a shaft 343 having bearings in plate 107′ of the printing section. Shaft 343 carries a horizontal crank arm 344, the rearward end 345 of which serves as a stop for finger 346 integral with the last pendulum member 121 on the left, which particular pendulum member has its upper end cut off so that it does not have the upwardly extending stop 121′. The link 341 is on the left hand side of the machine, but the rock shaft 343 crosses over through the printing mechanism from one side to the other so that the danger signal is printed to the right of the subtracted item. The action of these parts is such that link 341 is pushed rearwardly through the effect of adding into the machine enough numbers to make the last numeral wheel show a "9" and the resulting release of the pendulum 121 will operate as previously described to hold the stop plate 117 in its down position and so will allow lug 116 to clear stop 118 thereby permitting the hammer to strike against the type, and the type in this instance is a single type member 347, Fig. 24, carried at the end of a stationary bracket 348, bolted to the side member 107 of the hammer section. The net result is that in case the calculating section is reaching almost its full capacity, the over-draft or limit character will appear on the paper as a warning to the operator.

In case of over-draft, and by this I mean subtracting out from the accumulating mechanism more than there is in it, the carrying mechanism will have the effect of setting the last or left hand wheel at the "9" position, even though but a single cent or unit be subtracted. This over-draft then

has the action of bringing the cam point 323 of the last numeral wheel into contact with the platform 322 of lever 320 and thereby through the action of the swinging arms 327 and 328 and the link 341 and its coöperating crank arms 342 and 344 acting in the hammer section to print the over-draft character or signal at the side of the subtracted item.

As stated, the over-draft mechanism also has the function of locking the machine against totaling whenever there is a "9" showing on the last wheel of the calculating mechanism. This result is attained through mechanism now to be described.

Mounted on the side of the swinging arm 328 (Fig. 10) is a roller 349 which controls the movement of the upper arm 350 of a bell crank pivoted at 351. The lower end of the bell crank consists of a hook 352 which can engage the front end of a swinging latch arm 353 pivoted at 354 to a stationary frame stud, this latch arm 353 being riveted to a swinging arm 355 connected at 356 to the slotted end of a long horizontal link 357 which extends forwardly along the base plate of the machine and terminates in an upwardly curved portion pivoted at 358 to the upper end of a crank 359. This crank is rigidly mounted on a rock shaft 360, which also carries a downwardly extending arm 361 to serve as a stop when it strikes the bottom plate of the machine. Shaft 360 carries in addition to the arm 359 a similar upwardly extending arm 362 (Fig. 8) the upper end of this arm being notched at 363 so that it can swing in under a stud 364 carried on the forward edge of the control plate of the total lever TL, thereby to serve as a lock for the total lever, preventing the operator from throwing that lever under certain conditions of the over-draft mechanism.

The energy necessary for shifting the long horizontal link 357 (Fig. 10) to throw in the lock for the total lever is furnished by a little coiled spring 365 located at the extreme lower and rear corner of the machine, as shown in Fig. 10, the spring there being shown as broken away at its middle, but having its rear end attached to a frame stud 366 and its front end attached at 367 to an arm 368 pivoted at 369 to the crank arm 355. The forward end of arm 368 can slide back and forth over the adjacent cross member of the machine and it is the full function of this member 368 to furnish an anchorage for the coiled spring 365 and to permit the use of a long spring.

It follows that when the machine enters the overdraft condition, the stop 349 will swing the arm 350 to unlatch hook 352 and the backward movement of the long horizontal link 357 will lock the total lever TL against movement until the machine has been returned from its over-draft setting. After the calculating section has returned from its over-draft condition, the first full operation of the machine will unlock the total lever so that the total can be taken. This result is attained through mechanism, which will now be described.

The main drive shaft 155 of the machine carries the control plate 154′ and pivoted to the side of this control plate is a long upwardly inclined link 370, the rear end of which is pivoted at 371 to the upper end of a rock beam 372, pivoted to swing about the center 354 and carrying at its lower end a stud 373 positioned to swing forwardly and strike against arm 355 working against the tension of the big spring 365 and serving to swing latch 353 upward into engagement with the hook 352 so that after the hook has been released by an upward swing of arm 329 (this result being attained by return of the over-draft lever 320 to normal) the hook 352 will latch under the arm 353 and hold all the parts in normal position with the total lever TL free.

As stated the machine will not take a total when in the over-draft position or when so much has been added that the last or left hand numeral wheel stands at "9", but can take a total immediately on return from either of those extremes, though as the machine comes back to zero on the first operation after an over-draft, it must be turned over once before the total can be taken.

Ribbon shift.

(Figs. 28 to 40.)

The printing ribbon of this machine is fed across automatically in front of the printing type and after it has been nearly unwound from one spool, is automatically reversed in direction, to unwind from the other spool. Also means is provided for gradually lifting both spools and their associated mechanism through a substantial distance and then lowering it again so that the type impressions will be scattered on the ribbon and so that maximum use may be had without renewing ribbons. The ribbon carrier mechanism is a unit in itself, readily detachable from other parts of the machine and connected in for operation through swinging arms which can be pulled away from their associated parts when the ribbon carrier is to be taken out of the machine.

Power for unwinding the ribbon comes in to a swinging arm 374 (Fig. 28) through a recessed block 375 which fits over a lug on the member 372 (Fig. 40) that member having a to-and-fro motion, each time the machine turns over. This arm 374 is pinned to the lower end of a vertical rock shaft 377 (Fig. 33) the top end of which is provided

with a crank arm 378 (Fig. 34) to which is attached a link 379 extending across to the opposite side of the ribbon carrier and there connected with a corresponding crank arm 380 clamped to another vertical rock shaft 381. The result is that when power comes in from the machine through the swinging arm 374 to move that arm back and forth at each movement of the machine, both of the vertical rock shafts 377 and 381 swing equally through a small angle. Mounted to turn on each of these rock shafts is a ribbon carrying spool made up of a central hub 382, a top flange 383 and a bottom flange 384, the top flange making frictional contact with one end of a leaf spring 385, the other end of which extends across to form a bearing for a vertical guide roller 386 over which the ribbon 387 passes in going from one spool to the other. Below the lower flange 384 of each drum and normally free to turn with respect thereto, is a gear 389 which comes into action whenever the direction of ribbon movement is to be changed and as a means for bringing this gear into action, there is provided on each spool, a swinging flap 390 over which the ribbon is wound. This flap carries at its lower end a finger 391 projecting down through a slot in the spool flange 384 and engaging with one end of a pawl 391′, the toothed end of which is spring pressed (see Fig. 32) to engage with the teeth of gear 389 when the ribbon has been unwound from the spool down to the last turn, or far enough to release flap 390 and so release the free end of the pawl and allow its working end to engage with the gear teeth.

It should be explained that the movement of the spools in one direction or the other, is brought about by a pair of swinging plates 392 and 393 pivoted respectively at 394 and 395 to the arms 374 and 380 and each serviceable as a pawl to permit forward movement of its own spool, but under certain conditions to prevent return movement thereof. These swinging plates are so connected that only one of them is working at any particular time. Each swinging plate is provided with a coiled spring 396 so that it yieldingly engages in the notched edge of the lower flange 384 of its spool and since the pivotal support for plate 392 moves with the swinging arm 374 and the pivotal support 395 of the other plate 393 swings with a similar arm 374′, one or the other of the swinging plates can serve to push on the notched edge of its spool flange and thus advance the ribbon in one direction or the other at each swing of the machine. These swinging plates carry tails provided with rollers 397 and 398 which bear against the edge of a long sliding plate 399 having notches at 400 and 401 to serve as cam faces to govern the position of those rollers and thereby to govern the setting of the swinging plates. This long sliding plate 399 shifts longitudinally each time the ribbon has been completely unwound from one or the other of the spools, the shifting movement being induced by a connecting bar 402 connected to a swinging arm 403 which is pivoted at 404 and is shifted with a quick snap by the mechanism now to be described.

When the ribbon has been unwound from a spool down to the last turn, the flap 390 will release and its finger 391 will allow pawl 391 to grip gear 389 and further movement of the spool will cause rotation of that gear and consequent rotation of another gear 405 meshing therewith. Gear 405 is on a shaft 406 to which is splined a drum 407, (Fig. 34) carrying one end of a chain 408, which passes over a sheave 409 (Fig. 28) and around a winding drum 410 to which it is attached. The chain continues over sheave 409′ and is similarly attached to another drum (similar to drum 407) adjacent the opposite spool. Rotation of gears 389 and 405 therefor causes rotation of drum 410, either in one direction or the other in accordance with the direction of movement of the ribbon. Immediately below drum 410 is a cam disk 412 free to turn about the pivotal center 413 of the drum and having a cut away portion 412′ by means of which it is controlled in its movement by a stud 414, positioned at the pivotal connection between two swinging arms 415 and 416, the former of which swings about center 413 below cam disk 412 and the latter of which swings about the stud 417 and is slotted to move longitudinally with respect to that stud and has a spring 418 impelling toward the cam plate 412 which it serves to govern. Stud 414 under the impulse of spring 418 bears against the end of a slot 419 in drum 410 and when that drum rotates is pushed back against the tension of spring 418 until it passes the dead center line with respect to the centers 417 and 413 and then jumps to the other end of slot 419 and so gives a quick throw to arm 415 and a quick snap to cam plate 412. This cam plate 412 has a working face 420 which can pass into contact with rollers 421 and 422 mounted on pins projecting from the plate 403 which swings about pivot 404 to move bar 402 when plate 399 is to be shifted. The swinging of cam plate 412 swings arm 403 and shifts plate 399 and cam faces 400 and 401 shift with respect to their rollers, releasing one of the spool engaging plates and throwing the other into action. This reverses the direction of movement of the spools and so winds up the ribbon the other way and thus the ribbon will automatically wind up and unwind, and the shift from one spool to the other is made with a

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snapping movement and the ribbon never has a chance to get slack, even at the instant of reversal.

In addition to the unwinding of the ribbon from either spool, it has an up and down movement to bring all parts of it equally into use. This up and down shift is effected through an arm 423 Fig. 40, which in the normal operation of the machine is given a slow up and down movement by means of a cam 424 moving with a ratchet 425, the rotation of which is effected by means of a pulling bar 426 pivoted to the rocking plate 372 which swings about center 354, at each operation of the machine, as heretofore explained. Arm 423 is attached to one end of a rock shaft 429 Fig. 28 and that rock shaft carries a pair of arms 430 each of which projects forward toward one of the spools and is connected through a link 431 to a plate 432 (Fig. 33) which underlies the corresponding ribbon spool, thus when the rock shaft turns, the toggle pushes up on plate 432 and moves the spool progressively along its supporting shaft 377 sliding it slowly up and down to change the relative position of the ribbon and the type. The ratchet plates 392 and 393 are broad enough to engage with the notched lower disk of the ribbon spool, irrespective of its altitude and so need not be raised and lowered, but substantially all of the other parts of the ribbon carrying mechanism move with the ribbon in response to the shifting of arm 423 and its associated toggle connections.

Carriage mechanism.

(Figs. 35, 37, 46, 49.)

A carriage for the platen and the rolls of paper is positioned at the rear end of the machine and is slidingly mounted on ball bearings, the balls of which run in grooves cut in the top and bottom edges of a supporting plate 433 from which the entire ribbon shifting mechanism is supported by means of a pair of brackets 434 and 435 each held in place by a pair of screws 436. The supporting bar 433 is detachably connected to one of the round frame members of the machine by means of a screw 440 engaging lug 437 which has a slight possible swinging movement on its supporting bar. There are provided two adjusting screws 438 and 439 (Fig. 52) which can be forced in against the cross bar, after first releasing the main screw 440, the result being to swing the entire carriage about the supporting cross member as an axis, thereby adjusting the contact at the platen roller, which, as will appear from Fig. 34, has its contact face positioned above the carriage supporting cross member of the frame.

The carriage includes end plates 441 and 442 and these are connected together by upper and lower bars 443 and 444 each of which is shaped to serve as a ball race for the bearing. At the top, the end plates 441 and 442 are connected by a shaft 445 carrying adjustable resilient guide fingers 446 and serving as the pivot about which the platen frame may swing. The platen frame comprises end plates 447 and 448 (Figs. 51 and 52) serving as bearings for the shaft of the platen 449 and swinging upward about shaft 445 as a center when the platen is to be lifted away from the printing ribbon. These platen end plates also serve as supports for a stationary bar 450 which supports a plurality of spring pressed swinging arms 451 at the lower end of which is a cross bar 452 carrying a plurality of short rubber rollers 453 which normally press yieldingly on the paper strip. Rigidly positioned above bar 450 is a paper cutting knife 454.

Platen shifting mechanism.

(Same figures.)

As a means for rotating the platen forwardly at each stroke of the machine, there is provided a ratchet 455 with a driving finger 456 actuated from a swinging center 457 and held to its work by a spring 458. This swinging center is on a rock arm 459 which oscillates about a center 460 against the tension of a spring 461 and carries at its lower end a cross bar 462 which passes across to the other side of the carriage and is there attached to a swinging arm 463. Suitable outward movement of cross bar 462 at each operation of the machine, swings plate 459 and so forces ratchet wheel 455 around a proper distance. The means for producing the periodic outward swing of bar 462 comprises a finger 464 pivoted to swing with a rock shaft 465 and carrying on its side and pivoted at 466, a supplementary finger 467 which comes into action only when a total is to be taken and when a double space is needed on the paper so that the printed record may conform in appearance with records now common. Rock shaft 465 is slung from suitable brackets 468 and each time the machine turns over, is rotated by means of the forwardly projecting arm 469 which reaches forward into contact with a pin 470 carried on the swinging plate 372 (Fig. 40), the oscillations of which, as previously recited, actuate the ribbon shifting mechanism through the swinging block 375 and the swinging arm 374 and also through the action of finger 426, shift cam 424 to raise or lower the ribbon. But when a total is to be taken, the auxiliary finger 467 is brought into action by means of a swinging cam plate 471 mounted on a sleeve 472 carried by rock shaft 465 and engaging a roller 473 carried on the auxiliary finger 467. Sleeve 472 can be turned by means of

a crank 474 actuated by a link 475 which reaches forward as shown in Fig. 40 for rock connection with a pin 476 carried on a swinging arm 477 pivoted at 478 and actuated by a link 479 which extends forward along the base 1 of the machine for connection to the total taking mechanism at rock shaft 26. The result is that when the machine is set to take a total, the auxiliary finger 467 will give bar 462 a shift corresponding to one space on the platen and then when the machine turns over to print the total, the main finger 464 will be swung in usual manner and in so doing, will swing the auxiliary finger 467 outward by still another roller 473 rolling on cam 471, thus giving a double space on the printed record. On restoration of the total taking mechanism to normal setting, the auxiliary finger 467 will be shifted back into its original position through the action of spring link 480 on link 475.

The mechanism whereby the carriage is shifted on its ball bearings from one side to the other across the machine when the pin 296 (Fig. 52) is swung back and forth by the motor and its clutch connections, includes a link 481 pivoted to a sliding block 482 having a pair of spring pressed pawls 483 which can engage with notches in a rotatable shaft 484 which crosses the entire width of the carriage and is supported therefrom by depending brackets 485. With the pawls in the notches the oscillatory movements of the link 481 will shift the entire carriage forward and back across the machine. By rotating shaft 484, as by turning the thumb nut 486 at one end thereof, the pawls 483 will slip from their notches and the entire carriage can then be shifted over to bring the pawls into engagement with another pair of notches, thereby changing the range of movement of the carriage and putting the two columns of figures further over on the paper. Accidental rotation of shaft 484 is prevented by means of a swinging arm 486′ carrying a lug for engagement with notches in a plate 487 pinned to shaft 484, this arm being maintained in contact with the plate by coiled spring 461, (which serves also to pull down on crank 461′ on shaft 460 to reverse pawl 456 after each stroke thereof) and swinging about a center 488. Also swinging from center 488, is an arm 489 (Fig. 51) the upper end of which serves as a retaining finger for an arm 490 swinging about a center 491 and rigidly attached to a thumb piece 492. It is a function of this arm 490 to govern the position of a swinging arm 493 rigidly attached to a notched swinging plate 494 pivoted to swing about a center 495. It is the function of this plate to swing down against the rear of the stationary supporting plate 433 there to engage with suitable pins 496, (Figs. 34 and 39) to lock the carriage against shifting movement and in order that this lock may be effective, it is necessary to rotate the cross bar 484 far enough to disengage the pawls 483 from the notches, thereby freeing the block 482 so that it may slide back and forth along the bar without producing movement in the bar.

Supported at the side of arm 493 is a finger piece 497 rigidly attached to the swinging arm 498 which supports the spacing bar 462 so that it is possible for the operator to reach across over the machine and by hand shift the platen, notch by notch, as may be desired. The return movements of the spacing bar, whether it is being operated by hand or by the swinging fingers, are effected by means of a coiled spring 499.

Supported immediately below the platen is a plate 500 Fig. 35, which is suspended from end plates 501 Fig. 37, one of which is connected through a link 502 to a part of the carriage frame slightly off center with respect to the axis 445 about which the platen swings, the result being that as the platen is swung up to expose the entries last printed, the plate 500 is shifted around by its toggle to bring its upper edge just below the printed entry, there to serve as a guide or ruler extending the entire width of the paper sheet. With the carriage mechanism above disclosed, no spacing stroke need be taken before taking a total, for the total can be taken immediately after any item is in. In many machines it is necessary to take this spacing stroke to re-arrange the carrying lugs before attempting to take total, but with the present machine no preliminary spacing stroke is necessary for anything the machine does. Throwing down the total lever gives the platen a double feed and the automatic shifting of the carriage makes it possible to print the items in different columns and by shifting the point at which the motor driven link connects with the carriage, the position of those columns may be shifted and a single sheet of paper may bear as many as four separate parallel columns.

Supporting stand.

(Figs. 48 and 50.)

The stand whereon the machine is mounted for commercial use, comprises four angle iron legs 503 held together at their lower ends by connecting bars 504 and suitably cross braced from similar members 505 at the top of the stand. Inclosed within each leg is a round post 506 carrying a caster 507 at its lower end. The upper ends of these posts are connected rigidly together by cross bars 508 and means is provided for shifting these posts with respect to the frame so that the stand is carried either on the

casters 507 or on rigid feet 509 positioned one at each corner of the base. This shifting mechanism comprises short toggles 510 pivoted to bell cranks 511 connected together in pairs by cross bars 512, two of the bell cranks being rigidly connected to a rock shaft 513 provided with swinging arms 514 extending downward and connected by a handle bar 515. With the handle bar down against the legs of the frame as shown in Fig. 50, the bell crank will be in released position and the weight of the machine and its supporting stand will be carried by the feet 509. If, however, the stand is to be moved about the room, the operator in taking hold of the handle 515 and pulling up on it to drag the machine about the room, will lift the frame with respect to the posts 506 and so will lift the weight from feet 509 and transfer it to casters 507. After the machine has been wheeled over to a new location, the release of the handle will immediately drop it onto the feet 509.

The motor control includes a treadle 516 supported from a cross shaft 517 at the rear side of the frame and serving to pull down on a chain 518 which leads to a motor controlling switch of the type shown and claimed in my application, Ser. No. 612,131 filed March 3, 1911, which switch device is so constructed that when the operator steps on the treadle, the motor switch closes instantly and the motor starts, but when the operator releases that treadle to open the motor switch, the opening does not take place immediately but is delayed for a brief interval of time, say a half minute. This delay permits the operator to leave the machine for a moment and he will find the motor running when he returns, but if he stays away for any considerable time, the switch will act to open the motor circuit and stop the rotation of the motor. This mode of control gives the operator the freedom of both hands.

The duplicator mechanism.

(Figs. 8, 10, 17, 53 to 57.)

I will now describe the mechanism for taking any number set up on the key-board and storing this number for future re-delivery to the machine. This mechanism I call a duplicator mechanism. In reality it comprises an automatic memorandum whereby the operator may, so to speak, "carry" any number which he has for any purpose once set up on the key-board and may then by shifting a single control, at any time, re-deliver this number to the machine for any operation of which the machine is capable, precisely as if he had again set up the number on the key-board.

In the side frames of the machine in front of the accumulator pinion 63 and alined radially with the shaft 69 carrying the racks and stop-noses, are four studs, two in each side of the machine, one of each pair being shown at 520, and 521, Fig. 54. The stud 520 is seated in a washer 522 counter-sunk into the machine frame and is secured by the screw 523 threaded into the stud 520 and having its head counter-sunk into the machine frame as shown. The corresponding pins 521 upon the opposite side of the machine are similarly mounted. The studs 520 and 521 have apertures therein radially alined with the shaft 69 in which are rigidly mounted by any suitable means, the rods 524 and 525. Slidably mounted upon the rods 524 and 525 is a table structure comprising a pair of arches 526, 526′ (Figs. 54 and 57). The arch 526 is sleeved by means of the sleeves 527 and 528 upon the rod 524 and the arch 526′ is similarly sleeved upon the rod 525 by means of the sleeves 527′ and 528′. Bridged across the tops of these arches and secured thereto by suitable screws 529′ (Fig. 17), is a plate 529 having a pair of brackets 530 and 530′ in which is mounted the duplicator shaft 531, having revolubly mounted thereon associated pairs of duplicator numeral wheels 532 and duplicator pinions 533, this structure being the same as that of the associated numeral wheels 64 and accumulator pinions 63, fully described hereinbefore. These duplicator numeral wheels are marked D_1 to D_9 in Fig. 1. Each duplicator pinion 533 has rigidly fastened thereto a plate 534 having formed thereon a stop tooth 535 as shown in Figs. 54 and 17 adapted to coöperate with stop teeth 536 depending from the plate 529 to stop each duplicator numeral wheel at its zero position. The duplicator pinions 533 are alined with the toothed stop-nose arms 70.

Revolubly mounted in the two side frames is a shaft 537 carrying rigidly mounted thereon the cranks 538 which in turn carry pitmen 539 pivotally connected at their lower ends with the shaft 531 upon which are mounted the duplicator pinions and duplicator numeral wheels. Bridged across the side frames of the machine is a bar 540 (Fig. 17) to which is secured by screws, such as 541, the angle bar 542, the angled portion 543 of which serves as a retaining tooth to prevent accidental rotation of the duplicator pinions when the latter are out of mesh with the stop-noses 70, the function of this tooth 543 being precisely the same as that of the tooth 67, previously described. It will be apparent from the description thus far that a partial rotation of the shaft 537 will serve to slide the shaft 531 radially toward or away from the stop noses 70, causing pinions 533 to mesh with stop noses 70 or to be locked by the tooth 543.

I will now describe the mechanism for throwing the duplicator pinions into or out

of mesh with the stop arms 70, (Fig. 53). Rigidly mounted upon the shaft 537 is an irregularly shaped plate 545 having thereupon a tooth 546 and a lug 547. Rotatably mounted upon the stud 548 in the side frame of the machine is the plate 549, arc-shaped at its upper and lower edges. This plate has in its lower edge the three notches 549[a], 549[b], 549[c], adapted to be engaged by the tooth 550 on the bell crank 551 mounted on stub shaft 552 and normally held in engagement with a notch by the spring 553 whose opposite end is anchored in a stud 554 mounted in the frame of the machine. Upon the plate 549 are two studs 555 and 556. These studs form guides for the release plate 557 slidably mounted on the studs by means of slots 558 and 559. The plate 557 is normally held up by the spring 560 anchored at its other end to the plate 549 but may be depressed by means of the knurled knob 561, which I have also marked DL to indicate "duplicator lever". The lower end of the plate 557 is arc-shaped to conform with the lower edge of the plate 549, except that it is smooth. It will be apparent that when the knob 561 is depressed, the lower edge 562 of the plate 557 will disengage the tooth 550 from whichever notch it is in and allow the plate 549 to be rocked either to the right or to the left. By this means the plate 549 can be positioned and locked with the tooth 550 in engagement with any one of the three notches. The plate 549 is restrained from excessive movement in either direction by the stud 563 coöperating with the arc-shaped slot 564 therein.

The plate 549, has projecting therefrom the two lugs 565 and 566 (Figs. 53 and 56). Pivotally mounted upon the stud 548 is the rocking plate 567 having ears 568 and 569 thereon radially less distant from the shaft 548 than are the lugs 565 and 566 just described, so that these lugs and ears may pass each other. The plate 567 is connected at its upper end with the plate 545 by means of the link 570. Loosely mounted upon the stud 548 are the two plates 571 and 572 having fingers 573 and 574 respectively thereon, which fingers are adapted to engage with the pairs of lugs 565 and 568, 566 and 569 respectively. The plates 571 and 572 are anchored by springs 575 and 576 to eyes 577 and 578 upon the repeater control hereinafter to be described. Pivotally connected with the plate 549 is a link 579 which is expanded at its upper end to provide the broad notch 580, coöperating with the lug 547 in a manner to be described, and the slot 581. Rotatably mounted upon a stud 580′ in the side frame of the machine is a bell crank comprising the arm 582 having thereon a roller 583 projecting into the slot 581 just described and the arm 584 which is bent outwardly as shown at 585 and coöperates with a roller 586 upon the disk 587 upon the extreme end of the main rock-shaft 155 of the machine. The bell crank 582—584 is normally held to the right, Fig. 53, by the spring 588 whose other end is anchored to a stud 589 in the frame of the machine. The shaft 174 hereinbefore described (which withdraws the zero pins) is connected by a crank 590 with a depending arm 591 having a slot and pin connection 592—593 with the plate 549. Thus when the plate 549 is swung to the left or in a counter-clock-wise direction, the shaft 174 will not be disturbed. When the plate 549, however, is swung to the right, the shaft 174 will be rocked and the zero pins withdrawn in the manner hereinbefore clearly explained.

In operation, when it is desired to roll a number into the duplicator pinions, the plate 549 is swung forward. In this position, the link 579 will be moved rearwardly until the rear end 580[a] of the notch 580 engages the lug 547, thus positively holding the plate 545 in the position illustrated in Fig. 53 wherein the numeral pinions are out of mesh with the stop-noses 70. In this position the lug 565 will be moved to the left and the finger 573 under the impulse of its spring 575 will tend to rock the plate 567 in a counter-clock-wise direction and thus through the intermediary of link 570 and rock-plate 545 throw the numeral pinions into mesh; this action, however, being prevented by the positive engagement just noted between the lug 547 and the rear end 580[a] of the notch 580. When the machine turns over, however, at the end of the forward stroke the roller 586 will engage the arm 584 of the bell crank 584—582 thus through the intermediary of roller 583, depressing the link 579 and releasing lug 547 whereupon the duplicator pinions 533 will snap into mesh with the stop nose arms and remain in mesh therewith during the rearward stroke thereof, thus rolling into the duplicator pinions whatever number had been set up upon the key-board. Having thus stored the number in the duplicator pinions, the operator re-sets the plate 549 to a central position, whereupon since the springs 575 and 576 are equal in strength, the parts return to the normal position shown in Fig. 53, the machine may now be operated for an indefinite period until such time as it is desired to reproduce the number stored in the duplicator pinions. When this is desired the plate 549 is set to the right whereupon the link 579 is pulled rearwardly and until the forward end 580[b] of the notch 580 impinges upon the lug 547, and positively swings the duplicator pinions into mesh with the stop nose arms before the turnover of the machine. In this position the lug 566 being swung to the left, the finger 574 would tend, under the influence of spring 576 to

swing plate 567 in a clockwise direction and thus snap the numeral pinions out of mesh. This action, however, is prevented by the engagement just noted, of the forward end 580ᵇ of the notch 580 with the lug 547. At the end of the forward stroke, however, the roller 586 trips the lever 584 releasing the lug 547, whereupon the duplicator pinions are snapped out of mesh with the stop-nose arms. Before the turn-over of the machine, the rock shaft 174 has been rocked to withdraw the zero stops by means of the link 591 and crank 590, leaving the stop noses free to swing forward, thus since the duplicator pinions are in mesh at the beginning of and throughout the forward stroke of the machine, each of these pinions will be rotated by the stop-nose with which it is engaged until its stop 535 engages with the stationary stop 536, thus setting its corresponding duplicator numeral wheel to the zero position and allowing the corresponding stop nose arm to swing to a position corresponding to whatever number was indicated by the duplicator numeral wheel. Thus the duplicator pinions act as a substitute for the key-board and the accumulating part of the machine is set up through them precisely as if the key-board had been fingered.

It is sometimes desirable to retain the number in the duplicator after it has been delivered to the machine, as for instance when the same number is to be repeatedly used throughout the course of calculation upon which the operator is engaged. For this purpose I provide a repeat control 595, which I have also marked DRL on the drawings to indicate "duplicator repeat lever," pivoted on a shaft 596 in the frame of the machine. The repeat control 595 is arc-shaped and knurled as shown, and has pivotally connected therewith a link 596, which at its other end is pivotally connected with the dog 597 rotatably mounted upon the stud 580′. It will be remembered that upon delivering to the machine, the duplicator pinions go into mesh before the beginning of the forward stroke. Now, when it is desired to retain the number in the duplicator pinions, the repeat control 595 is rocked backward, whereupon the disk 597 slips under the tooth 546 and prevents the pinions from snapping out of mesh at the end of the forward stroke and the number is rolled back into these pinions on the back stroke of the machine. After the operation of the machine, the repeat control is set back to its normal position, the plate 549 is also set back to normal position whereupon the duplicator pinions move out of mesh with the number just delivered to the machine still retained therein.

I have provided simple connections whereby during the shift of these controls the machine is locked precisely as it is locked during the shift of any other control. This mechanism comprises a link 598 having a forked end 599 engaging with a pin 600 on the arm 601 rigid with shaft 206 carrying arms 602 connected to rod 62′. When the push button 561 is depressed, the rod 62′ will be lowered, thus rocking the plate 205 and locking the machine, as heretofore fully described. For locking the machine during the shifting of the repeat control 595, I provide the lower end of this control with a cam projection 602 which coöperates with a cam roller upon an arm 603 pivoted upon a stud 604 mounted in the frame of the machine and normally held to its duty by the spring 605 whose other end is anchored to a stud 606 in the frame of the machine. The arm 603 carries a depending projection upon which is mounted a roller engaging with the wing projection 608 from the arm 601 hereinbefore described. Thus while the repeat control 595 is moving from one position to the other, the rod 62′ is rolled and the machine locked against movement.

An important feature of my new duplicating mechanism is, that it is structurally independent from any of the other controls or operating parts of the machine, though functionally it coöperates with the machine as a whole. Thus the duplicator mechanism operates in reality as a substitute-key-board and a number previously rolled into the duplicator pinions can be delivered to the machine for any operation of which the machine is capable. Moreover, by means of the repeat control the same number may be returned into the machine again and again either consecutively (in connection with the repeat lever of the machine) or from time to time as the operators may desire. I consider this duplicator mechanism of vital importance and broadly new.

Various changes in construction and arrangement of the several parts of this calculating machine may be made without departing from the spirit of my invention as defined by the appended claims.

I claim:

1. In a calculating machine, a casing, a plurality of transverse shafts mounted therein, a series of partitions removably supported on and slidably engaging said shafts, releasable means for retaining said sections in position on said shafts and adapted to be lifted away therefrom, key mechanism carried by each partition and removable therewith, and a section secured to each partition, said sections fitting together removably and forming a portion of the casing top or cover.

2. In a calculating machine, a casing, a plurality of transverse shafts mounted therein, a series of partitions removably supported on and slidably engaging said shafts, releasable means for retaining said sections in position on said shafts and adapted to

be lifted away therefrom, key mechanism carried by each partition and removable therewith.

3. In a computing machine, a frame, a plurality of key-board sections removably mounted in said frame and accumulator mechanism including transfer devices operable from the key-board sections, means for preventing the transfer action of the transfer device, whereby the coöperating key-board section may be withdrawn without affecting the operation of the machine.

4. In a calculating machine, a depressible key stem carrying a lug, a swinging stop for holding said key depressed, a stop wire, and a swinging connection between said stop wire and said key stop to permit movement of said wire while said key is depressed.

5. In a calculating machine, a swinging stop nose, stop wires therefor, keys for controlling said stop wires and yielding connections between said stop wires and said keys permitting said stop nose to swing backward over said stop wires, brushing them aside, while their respective keys are still in depressed condition.

6. In a calculating machine, a stop wire, a key, a swinging stop nose, connections between the key and the stop wire whereby the wire is yieldingly held in the path of the stop nose after the key has been depressed.

7. In a calculating machine, a stop device, a stop nose, one of said elements having a beveled face whereby the two may relatively pass each other in one direction, and key controlled means for resiliently forcing said stop device into the path of said stop nose when the key is depressed.

8. In a calculating machine, depressible key stems, a swinging stop for engagement with each key stem to hold its key in depressed position, a stop wire and a pivoted member swinging with said key stop to thrust said wire into stopping position, but movable independently of said key stop to allow return movement of said stop wire even though the key remains depressed.

9. In a calculating machine, a plurality of keys, a plurality of stop wires, swinging elements connected to the stop wires and adapted to thrust the latter into stopping position, stops for retaining depressed keys mounted behind the swinging elements whereby movement of the stops in one direction will positively shift the swinging elements, said elements, however, being movable independently of the stops.

10. In apparatus of the class described, a plurality of keys, a plurality of stop wires, swinging elements connected to the stop wires, swinging stops associated with said elements and adapted to retain the keys in depressed position, said swinging elements being disconnected from the swinging stops whereby the stop wire may be moved when a key is in depressed position.

11. In apparatus of the class described, accumulator mechanism, swinging stop noses for operating said accumulator mechanism, a series of keys arranged in rows, a series of stop wires, connections between said wires and keys whereby the wires may be individually advanced through the keys into the path of the stop noses, all so constructed and arranged that the wires will only stop the noses when the latter are moving in one direction.

12. In a calculating machine, a depressible key stem carrying a lug and swinging stirrup for engagement with said lug, a saddle member capable of swinging with said stirrup, a stop wire pivoted to said saddle member, and a spring urging said stirrup into stopping position, said saddle member being capable of movement independently of said stirrup to re-direct the stop wire even though the key stem be still held by its stirrup stop.

13. In a calculating machine, the combination of depressible key stems, a plurality of sets of stop wires actuated thereby, a swinging stop nose for each set of wires, connection between said stop wires and their respective keys, permitting return movement of the wires even though the keys be down, and a member movable to positively return the stop wires and release depressed keys.

14. In a calculating machine, a key-board section having depressible key stems, stop mechanism for each key stem to hold its key in depressed position, a stop wire controlled through said stop mechanism and means effective for disconnecting each stop wire from its controlling key for withdrawing the stop wires from stopping position independent of the position of their respective key stems.

15. In a calculating machine, depressible key stems, stop wires actuated thereby, connecting means between said wires and said stems, and a sliding plate for swinging said connecting means to positively return the stop wire and to release depressed keys.

16. In a calculating machine, depressible key stems, stop wires actuated thereby, connecting means between said wires and said stems, and means for swinging said connecting means to positively return the stop wire and to release depressed keys.

17. In a calculating machine, depressible key stems in sections, stop wires actuated thereby, connecting means between said wires and said stems, and a sliding plate for each section for swinging said connecting means to forcibly return the stop wire and to release depressed keys, and a correction

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key for each sliding plate to release all the depressed keys of any one section, independently of the other sections.

18. In apparatus of the class described, a key-board including a plurality of rows of keys, accumulator sections, stop noses, stop wires normally automatically movable into stopping position upon the depression of keys, manually operable means for disconnecting the stop wires and keys and maintaining the stop wires in inoperative position, means for rendering said last named means inoperative during a portion of every turnover of the machine.

19. In a calculating machine, the combination of depressible key stems, accumulator mechanism, swinging stop noses, adapted to be controlled either through the key stems or through the accumulator mechanism, stop wires for the stop noses, connections between the key stems and the stop wires, a correction key for effectively disconnecting the stop wires from the key stems and returning the latter independently of the positions of the key stems, means for temporarily rendering the connection key inoperative during the normal operation of the machine.

20. In a calculating machine, accumulator sections, stop noses associated therewith, a set of keys, means whereby the depression of individual keys determines the position of the stop noses, means prevailing over said last named means whereby the position of the stop noses is rendered independent of the depressions of individual keys, means for rendering inoperative the last named means during a portion of each cycle in the operation of the machine.

21. In a calculating machine, the combination of an accumulator, stop noses controlling the movements of the accumulator, and stop wires, depressible key stems whereby said stop wires may be put in stopping position, the connections between the key stems and the stop wires being such that the stop wires will not interfere with the return movement of the stop noses even though they lie in the return path of the stop noses and must be moved thereby.

22. In a device of the class described, a lever carrying type at one end, and a stop nose at the other end, a rock shaft serving as a support for said lever, a separate rack arm also supported by said rock shaft and a friction connection betwen said rock shaft and said lever and between said rock shaft and said rack arm.

23. In a device of the class described, the combination of a lever carrying type at one end and a stop nose at the other, a swinging support for said lever, friction means for yieldingly holding the type bearing lever to the support, a separate swinging rack arm carried by said support and friction means for yieldingly holding the rack arm to the support, and means for swinging the support to swing said lever and its type and to swing said rack arm.

24. In a calculating machine, a shaft, means for rocking the shaft, a collar frictionally mounted on the shaft and having a stop nose and a type carrier thereon, a separate rack arm frictionally mounted on the shaft, a stationary stopping member for limiting the travel of the stop nose in one direction, selectively operable devices for limiting the travel of the stop nose in the other direction at variable points.

25. In apparatus of the class described, a rocking member, a collar frictionally mounted on the rocking member and carrying a stop nose and a type head, a rack having a slip connection with the collar, manipulative means for variously limiting the forward travel of the stop nose, releasable means for locking the rack to the stop nose whereby when said last named means are released the rack may travel on after the stop nose has been stopped.

26. In a calculating machine, a rock shaft, a member frictionally mounted upon the rock shaft and carrying a stop nose and a type carrier, a segmental rack frictionally mounted at its center upon the rock shaft, an accumulator element adapted to be operated by the rack, manipulative means for selectively limiting the forward travel of one of the frictionally mounted members, locking mechanism whereby the stop nose and the rack are locked for movement together, including means whereby, when unlocked, one of said members may travel a distance corresponding to the space of one rack tooth with respect to the other, stationary means for limiting the rearward travel of one of said members whereby when the locking mechanism is released one of said members will travel the space of one rack tooth beyond the travel of the other.

27. In a calculating machine, a rocking shaft, a plurality of members frictionally mounted on said rocking shaft and each carrying a stop nose and a type head, segmental racks frictionally mounted on said shaft and having a slip connection with each of said members, accumulator mechanism operable by said racks and including tripping devices, selectively operative mechanisms associated with each member and rack, and adapted to limit the forward travel of one thereof, stationary means adapted to limit the rearward travel of one thereof, a latch and means to permit the racks and members to shift a distance of one rack tooth relatively to each other when the latch is tripped.

28. In a calculating machine, a rocking shaft, a member comprising a stop nose, frictionally associated with said shaft,

another member frictionally associated with the shaft and with the stop nose for operating an accumulator section, a latch device for locking said two members together as regards angular movement about the shaft, means for limiting the rearward movement of one of said members whereby when the latch is tripped one of said members will have traveled beyond the other at the end of the rearward rocking movement of the shaft.

29. In a calculating machine, a rock shaft, a member comprising a stop nose frictionally associated with said shaft, another member frictionally associated with the shaft and with the stop nose for operating an accumulator section, a latch device for locking said two members together as regards angular movement about the shaft, means for limiting movement of one of said members whereby when the latch is tripped one of said members will have traveled beyond the other at the end of the rearward rocking movement of the shaft, and means for thereafter realining said members and relatching the latch device.

30. In a calculating machine, a rock shaft, means for causing the rock shaft to make a partial rotation and return, stop noses and racks frictionally mounted on said rock shaft, means for limiting the swing of the stop noses in either direction, latch devices for causing the stop noses and racks to move together, tripping devices for releasing the latches whereby when the latch is released the racks will move beyond the stop noses at the end of the return swing of the rock shaft, means for thereafter and realining said racks and stop noses and relatching the latch devices.

31. In a device of the class described, a type bearing lever, a friction support for said lever, a swinging rack carried by said support and movable with respect to said lever and means for operating the friction support to swing said rack and said lever, and means for retarding the movement of the lever to shift its position with respect to said rack.

32. In a device of the class described, the combination of a type bearing lever having a stop nose, a support for said lever, friction means yieldingly holding said lever to the support, a rack carried by said support and capable of swinging with respect to said lever, means for operating the supporting means and means for retarding the movement of the type bearing lever, while permitting a limited further movement of said rack.

33. In a device of the class described, the combination of a rock shaft, spools and disks placed alternately on said shaft and swinging therewith, means for yieldingly holding said spools and disks toward each other and a type bearing lever carried by said rock shaft between a spool and a disk and frictionally driven thereby when the rock shaft turns, whereby the stopping of said lever will not stop the shaft and soft metal pads on said lever and frictionally engaged between said spool and disk.

34. In a device of the class described, the combination of a rock shaft, friction spools and disks fixed to swing with said shaft and slidable thereon, there being at least one disk between each pair of spools, said spools and disks being held toward one another by spring pressure and type bearing arms, each of which is frictionally engaged by the adjacent sides of a spool and disk, means for swinging the rock shaft to swing the type bearing arms, and manually operated stops for checking the movement of said arms.

35. In a device of the class described, the combination of a rock shaft, means for swinging it, a pair of spools, and a collar mounted upon said shaft and swinging therewith, a shoulder on said collar and a type bearing arm mounted thereon and held between said collar and one of said spools and a swinging rack arm frictionally held between the other side of the collar and the other spool.

36. In a device of the class described, the combination of a rock shaft, and type bearing levers and rack arms mounted thereon and capable of independent movement, latching means for connecting each rack bar with one of said levers for simultaneous operation, a series of spools and disks mounted on said rock shaft to turn therewith and free to slide thereon, said rack arms and said levers being positioned in pairs in frictional engagement with the opposite sides of the disks.

37. In a machine of the class described, calculating mechanism arranged in sections and including transfer mechanism, shafts, each of said sections including a plate having an element of the transfer mechanism mounted thereon and provided with open ended slots, said slots being slidable onto and off of said shafts in a direction transverse to the length of said shafts, whereby said plates and attached transfer parts may be selectively removed or interchanged.

38. In a machine of the class described, an accumulator comprising a plurality of sections, each removable from the machine as a unit without disturbing the other sections, numeral wheels and a cam adjacent to each numeral wheel and coöperating with one of said sections to unlatch the same when a transfer is to be made from one section to the next.

39. In a calculating machine, an accumulator section comprising a plate having recesses therein adapted to removably fit upon

appropriate rods in the machine, staffs mounted in said plate, a cover plate removably secured to said staffs, a trip lever pivotally mounted between said plates, a lever controlled by said trip lever, a link secured to said last named lever for operating a latch, all for the purpose described.

40. In apparatus of the class described, a plurality of accumulator pinions, a plurality of racks for operating said pinions, stop noses associated with said racks, selective means for variously limiting the movement of said stop noses, means for preventing relative movement between the racks and the stop noses, transfer mechanism for releasing said preventive means whereby the racks and stop noses may have a relative movement, said last named mechanism being controlled in accordance with the setting of the accumulator pinions, means for repositioning the stop noses and racks and simultaneously resetting the movement preventing devices.

41. In a machine of the class described, a swinging rock shaft, stop nose arms frictionally driven thereby, stop wires positioned to determine the swing of the various stop noses, a swinging rack carried by said rock shaft, accumulator wheels adapted to be brought into mesh with their respective racks, sectionalized transfer mechanism actuated in accordance with the setting of the corresponding numeral wheels and connections from said transfer sections to their respective stop noses to permit slipping of the stop noses with respect to their racks in either direction when a transfer is to be made from one numeral wheel to the next.

42. In a machine of the class described having swinging stop noses, and stop wires for regulating the swing of those noses, the combination of numeral wheels, swinging racks with which those wheels may be thrown in mesh and transfer mechanism operative through the action of said numeral wheels to slip said racks with respect to their stop noses in either direction to transfer across the machine in either direction from one numeral wheel to the next.

43. In a machine of the class described, the combination of a rock shaft, type bearing levers frictionally driven by said rock shaft and each bearing a stop nose, swinging rack arms frictionally driven by said rock shaft, latching means holding said rack arms to move with said stop noses, numeral wheels each provided with a cam and means interposed between each cam and the latching means to a stop nose for releasing the swinging rack and allowing it to slip in either direction with respect to its stop nose by a distance equivalent to one tooth of the rack.

44. In a machine of the class described, the combination of a rock shaft, swinging levers frictionally driven thereby each carrying printing means at one end and a stop nose at their other, a swinging rack carried by said rock shaft, accumulator wheels meshing with said racks and means for slipping a rack with respect to its stop nose when the corresponding accumulator wheel has made one complete revolution and must transfer across to the next adjacent wheel.

45. In a calculating machine having a swinging stop nose arm with a type bearing head at one end, the combination with spring pressed type mounted in each of said heads and a ribbon guard positioned at the side of each head and projecting beyond the inactive position of the type faces.

46. In a calculating machine, swinging racks, accumulator pinions adapted to mesh with said racks, a lever and mechanism associated therewith for snapping said pinions into mesh with said racks at the beginning of the forward stroke of the latter and out of mesh at the end of the forward stroke thereof, or vice versa, according to the setting of said lever, a control lever for said swinging lever adapted to assume two positions, connections between the control lever and the lever whereby, in whichever position the control lever may be, it may move substantially to the opposite position before disturbing the setting of the swinging lever and thereafter in its continued movement will quickly snap the swinging lever to the opposite position, and means for locking the machine during the shifting of the control lever.

47. In a calculating machine, swinging racks, numeral pinions, a swinging lever, spring devices and mechanisms associated with said lever for snapping said accumulator pinions into mesh with the swinging racks at times controlled by the setting of said swinging lever, a shiftable control device for controlling the setting of the swinging lever, connections between the control devices and the lever whereby the control device may move from the position corresponding to either setting of the lever, substantially to a position corresponding to the other setting of the lever, without disturbing the lever, and means for locking the machine during the shift of the control lever.

48. In a machine of the class described, the combination of swinging racks, pinions for meshing with said racks, and a spring tension device for snapping said pinions into mesh with the racks and means for reversing said tension device subsequently to snap the pinions out of mesh with their racks.

49. In a machine of the class described, the combination of a main drive shaft, a plate swinging therewith, a tension device actuated by said plate, swinging racks, pinions for meshing with said racks and releasing mechanism associated with said ten-

sion device and coöperating with said swinging plate to shift the pinions with respect to their racks at the proper moment.

50. In a calculating machine, swinging racks, stop noses, stop wires, numeral pinions having stop devices thereon, totaling elements comprising means movable into position for engagement by said stop devices, means to snap the pinions into engagement with the racks at the beginning of the swing thereof, and means to withdraw the stop wires whereby the control of the racks is shifted from the stop noses to the stop devices and the racks are set to a position corresponding to the total while the machine is cleared.

51. In a machine of the class described, the combination of a shifting carriage, a platen carried thereon, printing mechanism coöperating with said platen, key-set mechanism for governing the action of the printing mechanism, an adding and subtracting lever, and power-driven means for shifting said carriage with respect to said printing mechanism when said adding and subtracting lever is shifted.

52. In a calculating machine having control means for changing from additions to subtractions, of a sliding carriage and power driven means for shifting said carriage automatically with the shifting of said control means.

53. In a calculating machine having a printing mechanism, and a key-board operatively connected to govern said mechanism, the combination of a sliding carriage, an accumulator, control mechanism for shifting said accumulator from additions to subtractions or vice versa, and means for positively shifting said carriage automatically when said control means is shifted.

54. An adding and subtracting machine having a sliding carriage, and power driven means for shifting said carriage automatically when said machine is changed from adding to subtracting.

55. In a calculating machine having a sliding carriage, the combination of a motor, clutch mechanism for connecting said motor with said carriage when the carriage is to be shifted and means for locking said clutch against operation when desired.

56. In a calculating machine having a sliding carriage, the combination of a continuously operating motor, a ratchet actuated thereby, a crank, clutch mechanism for connecting said crank to turn with said ratchet and connections between said crank and said carriage whereby said carriage may be shifted, said crank starting from dead center and stopping at dead center with respect to said connections.

57. In a calculating machine having printing mechanism and manipulative devices for governing said mechanism, the combination of an accumulator adapted to add or subtract, a carriage control mechanism for automatically positively shifting said carriage at the change from the adding to the subtracting operation of the accumulator or vice versa, and means for rendering said shifting mechanism inoperative.

58. In a calculating mechanism adapted to add or subtract, printing devices including a shiftable carriage, means for shifting said carriage at each change from addition to subtraction or vice versa, whereby amounts added and subtracted are printed in different columns.

59. In a calculating machine having control mechanism for shifting from additions to subtractions, the combination of a sliding carriage and continuously operating motor, a clutch mechanism responsive to the condition of the machine whether set for additions or subtractions and operative to connect said motor with said sliding carriage to shift the carriage so that added items may be printed in one column and subtracted items in another column.

60. In a calculating machine having a printing mechanism, an accumulator, and means for printing a total, a platen, means for shifting paper over said platen at each stroke of the printing mechanism, and means for giving a double shift to the paper when a total is to be printed.

61. In a calculating machine having an accumulator, a printing mechanism and a total lever for setting the printing mechanism to print the total in the accumulator, of a platen shifting means and means for giving the platen a double shift when the printing mechanism is to print a total.

62. In a calculating machine, a sliding platen carriage, power driven means for shifting said carriage and means for interrupting said driving connection and locking said carriage against sliding movement when desired.

63. In a calculating machine having an accumulator, printing means and key-set mechanism for controlling the accumulator, means for printing a total as indicated by the accumulator and means for locking the machine against printing when the accumulator is in an over-draft condition.

64. In a machine of the class described having a printing mechanism, an accumulator and manually controlled means for governing the accumulator, of a total lever, and means for locking said total lever when the accumulator is in an over-draft condition.

65. In a machine of the class described having a plurality of number wheels and means for transferring the rotation of one wheel to an adjacent wheel, of a cam carried by the last wheel of the series, printing mechanism operative to produce a permanent record of the setting of the accumula-

tor while adding or subtracting normally, and means actuated by said cam for printing on said record a special over-draft character when subtracted items have run the numeral wheels beyond their lower limit and thereby have swung the last wheel of the series backward from its zero to its nine position.

66. In a calculating mechanism, key-set device, stop nose arms controllable therefrom and having rack teeth, duplicator pinions having stops, other stops adjacent thereto, means to cause the duplicator pinions to mesh with the stop nose rack teeth during one movement of the latter, whereby the pinion stops are moved away from the other stops, means to cause the duplicator pinions to mesh with the stop nose rack teeth during another movement of the latter whereby said stops are brought together to selectively limit the movement of the stop nose arms in accord with the setting of the duplicator stops.

67. In a calculating machine including swinging actuating devices, a duplicator mechanism comprising duplicator pinions adapted to be swung into or out of mesh with said actuating devices, means for positively holding the duplicator pinions selectively in or out of mesh, means for simultaneously imparting a tension to said duplicator mechanism to shift it in the opposite direction and means for tripping said positively engaging means at the end of the first half cycle of the machine operation, whereby said pinions are snapped out of or into mesh as the case may be.

68. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are each detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, and means for rotating the calculating wheels in opposite directions.

69. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are each detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, a calculating rack for each of the calculating wheels, and means for driving the racks for rotating the calculating wheels in either direction, and means to cause said racks and wheels to engage and disengage at different points in the operative cycle of the machine.

70. In a calculating machine, a spring operated totalizing mechanism, an adding and a subtracting lever for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby the parts are returned to their normal position after the completion of the addition or subtraction, and locking means for holding the parts of the device in their proper positions while the calculating mechanisms are completing their operations and later releases same to allow spring to act.

71. In a calculating machine, an automatic calculating mechanism, means for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby the parts are returned to their normal position after the completion of the addition or subtraction, a printing mechanism operatively connected with the calculating mechanism for automatically printing the numbers which are added or subtracted, a carriage in the printing mechanism, and means for automatically shifting the carriage when the subtracting lever is operated to list the subtracted numbers in a column separate from the column used in listing the added numbers.

72. In a calculating machine, a key controlled automatic calculating mechanism, an adding and a subtracting lever for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby the parts are returned to their normal position after the completion of the addition or subtraction, a printing mechanism operatively connected with the calculating mechanism for automatically printing the numbers which are added or subtracted, a carriage in the printing mechanism, and means for automatically shifting the carriage when the subtracting lever is operated to list the subtracted numbers in a column separate from the column used in listing the added numbers.

73. In a calculating machine, a series of numeral wheels, and a carry-over mechanism associated with said numeral wheels, said mechanism consisting of a plurality of independently removable sections, there being a section for each but the highest order numeral wheel.

74. In a calculating machine, a plurality of calculating sections, key-controlled mechanism for operating said calculating sections to perform addition or subtraction, a plurality of transverse shafts mounted in said machine, each of said sections slidably engaging said shafts, and releasable means for retaining said sections in position on said shafts.

75. In a calculating machine, the combination of a rock shaft, a plurality of friction members rigidly mounted thereon, each member consisting of a sleeve which terminates at either end in a disk provided with an axial flange, the flanges of adjacent disks extending toward each other to present op-

posing friction surfaces, a collar held between each pair of opposing flanges, a type arm frictionally held between one face of said collar and the adjacent disk, and a rack arm frictionally held between the other face of said collar and its adjacent disk, calculating mechanism adapted to be actuated by said arms, and means for yieldably forcing said friction members together.

76. In a calculating machine, the combination of a rock shaft, a plurality of friction members rigidly mounted thereon, each member consisting of a sleeve which terminates at either end in a disk provided with an axial flange, the flanges of adjacent disks extending toward each other to present opposing friction surfaces, an intermediate disk mounted on said shaft between each pair of opposing flanges and provided with a peripheral frictional flange in alinement with the flanges on either side thereof, an actuating arm held frictionally between each intermediate disk and one of the adjacent end disks, a controlling arm held frictionally between each intermediate disk and the other adjacent end disk for controlling the operation of the associated actuating arm, means for yieldably forcing said friction members together, and calculating mechanism adapted to be operated by said actuating arms.

77. In a calculating machine, the combination of a rock shaft, a pair of end disks mounted thereon, an intermediate disk mounted on said shaft between said end disks, said disks being provided with opposing frictional flanges, a type lever held frictionally between the intermediate disk and one of the end disks, a rack arm held frictionally between the intermediate disk and the other end disk, and means for yieldably forcing said disks together.

78. In a calculating machine, the combination of a shaft, a pair of friction members mounted thereon, an arm held frictionally between said members, said arm having a soft metal pad on each side thereof, said pads frictionally engaging the adjacent faces of said friction members respectively, a calculating device adapted to be operated by said arm, and means for yieldably forcing said members together.

79. In a calculating machine, the combination of a shaft, an arm, frictional means for operatively supporting said arm on said shaft, said frictional means including restricted annular contact surfaces between which said arm is frictionally held, said arm having a soft metal pad on each side thereof to frictionally engage said surfaces, and a calculating device adapted to be operated by said arm.

80. In a calculating machine, the combination of a series of numeral wheels, a toothed sector associated with each numeral wheel for operating the same a predetermined amount, a key-controlled arm associated with said sector for controlling the operation thereof, a pin-and-slot connection between each sector and its arm to permit a one-space movement of the sector in either direction independently of the associated arm, means for normally locking each sector and its arm together for simultaneous operation, connections between the numeral wheels and said locking means, whereby a lower-order wheel on passing through zero automatically releases the sector of a higher-order wheel to carry one unit into the higher-order wheel, and means for locking any desired sector against release to prevent carrying through that sector.

81. In a calculating machine, the combination of a rock shaft, a pair of friction disks rigidly mounted thereon, said disks being provided with peripheral flanges, an arm held frictionally between said flanges, an indicating member adapted to be actuated by said arm, and means for yieldably forcing said disks together.

82. In a calculating machine, the combination of calculating wheels, a key-controlled rack associated with each wheel for actuating the same, means for operating said racks to clear the numeral wheels, a key-controlled stop-arm associated with each numeral wheel, and a lug provided for each numeral wheel to engage said arm when the numeral wheel reaches zero position.

83. In a calculating machine, the combination of calculating wheels adapted to receive entries, supplemental mechanism arranged to be operated in accordance with the indication of said calculating wheels at any time, a sectional keyboard, means for locking said sections in position, and means controlled by said mechanism for releasing said locking means.

In witness whereof, I hereunto subscribe my name to this specification in the presence of two witnesses.

MARTIN TEETOR.

Witnesses:
F. C. BELL,
H. C. BLACKBURN.

PATENT SPECIFICATION

Convention Date (United States): Apr. 18, 1914.

Application Date (in United Kingdom): Jan. 17, 1920

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No. 1577/20.

COMPLETE SPECIFICATION.

Improvements in Calculating Machines.

We, THE TEETOR COMPANY of 720, Sixth Avenue, Des Moines, State of Iowa, United States of America, Assignees of [illegible] Teetor, of the above address, [illegible] former address was Box 475 Des Moines, State of Iowa, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to calculating machines of the multiple-bank, key-set, independently-operated type, having differentially displaced and restored actuating toothed-members, together with totaliser pinions adapted to be engaged and disengaged therefrom, wherein manually operated controlling means are provided adapted to cause a reversal of the order of engagement and disengagement between the differential actuating toothed members and the totaliser pinions, upon the movement of the main operating member, for the purpose of effecting addition or subtraction.

The invention consists in a calculating machine provided with a reversing lever or the equivalent having mechanism associated therewith comprising a quick action release for snapping a totaliser pinion into and out of mesh with a differential actuating rack while the rack is at the beginning or end of its forward swing whereby subtraction or addition can be effected.

The invention also consists in the provision of a control lever device for the said reversing lever and connections between the two so that the device may move from the position corresponding to [illegible] setting of the reversing lever, substantially to a position corresponding to the other setting of the lever, without disturbing the reversing lever, the machine being locked during the shifting of the said reversing lever.

The invention further consists in mounting the differential actuating rack arms between pairs of friction members that are mounted upon a main rock-shaft, the said members being yieldingly forced together.

Other features and advantages are referred to hereinafter.

In the accompanying drawings illustrating a preferred embodiment of the invention:

Fig. 1 is a plan of a machine of the type in which the invention is incorporated.

Fig. 2 is a horizontal section showing in plan the main rock shaft and the type-bearing lever, and also certain other parts.

Fig. 3 is a transverse section through the keyboard and accumulator mechanism.

Fig. 4 is a longitudinal section just inside the right hand side plate.

Fig. 5 is a sectional detail of the slip joint whereby the stop noses and the swinging racks are swung from the main rock shaft.

Fig. 6 is a perspective view of the lever control L and the reversing gear governed thereby, whereby the machine is shifted over from an adding to a subtracting machine.

Fig. 7 is a detail of the tension device appearing at the centre of Fig. 6.

Fig. 8 is a side elevation of the eliminating lever including its connections running through to co-operate with some of the parts shown in Fig. 6 to hold the accumulator out of action while permitting the

[*Price* 1/-]



printing device to record an invoice number or the like.

Fig. 9 is a detail of the sub-total lever.

Fig. 10 is a detail of the total lever.

Referring to the drawings it will be seen that the machine casing comprises a base plate 1 (*Fig. 3*) and a suitable covering hood having sides 2 and 3 and a top 4, the top having glazed openings 5 exposing the little windows at which numeral wheels N^1—N^9 appear, and duplicator pinions D^1—D^9.

The keyboard is sectionalized with the keys grouped according to standard practice. The keys are numbered respectively S^1—S^9. Each keyboard section comprises wall plate 6 (Fig. 2) arranged to support the key-stem, stop wires and other operative parts of the section. At its front the plate carries flange 7 serving to close the front of the keyboard when completely assembled. At the top edge of plate 6 is a flange or transverse plate 8 having slots to receive the key-stems 9 (Fig. 3).

In Fig. 1 are also the following references denoting the several parts; R, the tripping rail; TL, the total lever; STL, the sub-total lever; L, the reversing lever; RL, the repeating lever; EL, the eliminating lever; CK, the correction key; CL, the carriage lock; and DL, the duplicator lever.

The control mechanism (Figs. 6, 7 and 8) determines whether the machine shall add or subtract when a certain number has been set up on the keyboard. This mechanism includes hand lever L pivoted to the machine frame, which, in its rearward position, Fig. 6, is in the adding position, but which can be swung forward into the subtracting position. When tilted backward, Fig. 6, roller 131 on lever L passes down over the lower lip of the recessed end of rock lever 132 on shaft 189 and swings that lever upward at its rear end, thereby pushing upward on link 133, the upper end of which carries roller 134 movable in the slot of plate 135, to which is rivetted plate 135^1. The construction permits roller 134, which has a flange on the inner side of slotted member 135 to pass the pivot of this member. Plate 135 has projecting arm 137 at its rear end, having a cam slot to receive roller 138 carried on the lower end of swinging arm 139, this arm being rigid on rock shaft 66 and serving to control the inward and outward swings of supporting arms 65 which carry accumulator or totalizer pinions 63, numeral wheels 64, stop cams 80^1 and totaling stops 80*a*.

Pivotally connected with the stud of roller 134 and with the upper end of link 133 is another link 140 pivoted to the upper end of controlling plate 141 pivoted on stub-shaft 142 and [illegible] roller 143 at its lower end and [illegible] *retaining* lug 144 at its rear [illegible] Auxiliary plate 145 is pivotally [illegible] on stub shaft 142 and can swing [illegible] respect to plate 141 and is used to [illegible] that plate under tension at each [illegible] or backward swing of the machine [illegible] that numeral wheels 63 will snap into [illegible] out of mesh at appropriate times. [illegible] effect this there is interposed between plate 145 and plate 141 spring 146 which is coiled about shaft 142 and has both of its ends projecting upward divergently, these ends being respectively anchored in guide plates 147 and 148, both of which are free to swing about shaft 142 and serve merely to hold the ends of the spring to their work. With the [illegible] as in Figs. 6 and 7 spring-supported [illegible] plate 147 will contact with stud 150 [illegible] the upper end of plate 141 and the [illegible] spring-holding plate 148 will [illegible] with stop 151 projecting from the top [illegible] auxiliary plate 145, thereby putting [illegible] two parts under tension and tending [illegible] swing stud 150 toward stop 151.

Referring to Fig. 4 the means for swinging auxiliary plate 145 consist of a pair of studs 152 and 153 mounted on the outer face of main controlling plate 154 which is driven and turns on shaft 155 forward and back at each swing of the machine. The upper edge of plate 154 has laterally projecting flange 156 which serves as a retaining cam for holding roller 143 against movement until the machine has reached just the proper point in its swing and thereupon releases that roller to allow plate 141 to snap over in response to the tension which in the meantime has been put on it through spring 146, for this spring meantime has been loaded by the swinging motion induced in plate 145 through engagement therewith of one or the other of studs 152 and 153. In other words the studs on plate 154 swing lever 145 backward and forward at every operation of the machine, thereby shifting the spring tension from one side to the other with respect to plate 141 and it is the function of roller 143 to prevent the parts from slipping through until the machine is in [illegible] position and this exact position is defined by the release of roller 143, by [illegible] flange 156 projecting laterally from the upper edge of plate 154, roller 143 [illegible]

confined beneath flange 156 on the first half of the cycle of the machine and above it during the second half thereof. The object of this mechanism is to shift accumulator pinions 63 into and out of mesh with racks 68 at the proper instant.

Fig. 6 illustrates the position of the parts before plate 154 has begun its forward stroke and when lever L is in its rearward or adding position. Roller 134 is then at the top of the slot in plate 135. The forward stroke of plate 154 will operate first to lock roller 143 by means of flange 156 and then to swing the lower end of lever 145 by impact thereupon of pin 153. Upper lug 151 on lever 145 will move guiding plate 148 to the right and tension spring 146 without, however, shifting pin 150, for the reason that control plate 141 is locked. As soon, however, as flange 156 has passed off roller 143 plate 141 is free to rock and under the tension of spring 146, applied through guide plate 147, will be swung to the right. This will communicate a rearward impulse to link 140, rocking the slotted plate 135 in a clockwise direction; which lowers arm 137 and by the caterpillar slot therein rocks lever 139 and causes accumulator or totalizer pinion 63 to go into mesh with rack 68. The return of plate 154 will first lock roller 143 *in its new position, thus holding* accumulator pinion 63 in mesh with rack 68 and thereafter pin 152 will impinge lever 145 putting tension on spring 146 in the opposite direction, so that at the end of the return stroke when roller 143 is released by flange 156, spring 146, acting this time through guide plate 148 will cause a forward impulse to be communicated to link 140, thus rocking slotted plate 135 in a counter clockwise direction, which, through the caterpillar slot in this member will swing arm 139 to the left and withdraw accumulator pinion 63 from mesh with rack 68. Thus, while the machine is adding, the accumulator pinions are held out of mesh on the forward stroke, put into mesh during the rearward stroke and automatically flipped out of mesh at the end of the rearward stroke.

The subtracting operation is analogous. In subtracting, lever L is in its forward position wherein lever 132 is tilted downwardly at its rear end by the roller 131 engaging the upper lip 131^b of the recessed end of lever 132, causing roller 134 to engage at the lower extremity of the slot in plate 135. *Precisely the same operation of the remaining parts will cause accumulator pinion 63 to be held in mesh* on the forward stroke, thrown out of mesh at the beginning of the rearward stroke, and flipped into mesh again at the end of the rearward stroke. This must be true because the operation of all the other parts being precisely the same in either case, in the subtracting operation link 140 (being lowered) communicates an impulse to the opposite end of pivoted plate 135 rocking this member in precisely the opposite direction each time to the direction it would rock it at the same stage of operation if adding were being performed. In reversing lever L in Fig. 6 from backward (addition) position to forward (subtraction) position it will be borne in mind that when roller 134 travels from the top of slot in plate 135 to the bottom that plate 135 will rotate on its center pivot and throw its upper end to its extreme right hand position instead of its extreme left hand position shown in Fig. 6, thus reversing the position of the numeral pinions with relation to the racks.

There is an auxiliary plate 157 (Fig. 4) pivoted on stub-shaft 158 and having laterally projecting stop 159, which will ride on the top edge of rock lever 132 when that lever has been tilted upward at its rear end for the adding position. But in case of subtraction, and with lever 132 tilted down out of the way, auxiliary plate 157 swings forward at its lower end under the driving action of coiled spring 160 so that notch 161 near its lower end may engage with laterally projecting stop 144 located on the rear corner of swinging plate 141. When lever 132 is set for subtraction, projection 144 will snap in under the shoulder at 161 as soon as it is released at the end of the forward stroke, this having the effect of positively keeping the numeral wheels out of mesh with the segmental racks (on the return stroke) until other operations have taken place, including rotation of lantern shaft 82 and re-engagement of latches 71 with their lugs 72 to again connect each segmental rack in its normal relation to its stop-nose arm. Swinging plate 157 continues to lock plate 141 against return movement until main plate 154 swings back far enough to bring lug 162 against the lower offset end of plate 157, and thereupon that plate is unlatched and plate 141 can swing back under the driving impulse of its spring 146, which *has long previously been shifted over to*

put the tension on in the other direction. Thus, with lever L in the adding position, the accumulator pinions are out of mesh at the beginning of the forward stroke and are flipped into mesh at the beginning of the rearward stroke while for subtraction they are put into mesh at the beginning of the forward stroke, flipped out at the beginning of the rearward stroke and positively held out until the end of the rearward stroke.

To deaden or cushion the swing of lever 137 its rear end is positioned to engage with shoulders on a sliding plate 137^1 (Fig. 4) movable up and down and frictionally retarded by a spring metal retaining plate 137^{11} having crimped ends engaged in the recessed ends of studs upon which plate 137^1 is slidably mounted.

It is an important advantage to have adding lever L first lock the machine, when it begins to swing and at the extremity of its swing unlock the machine, substantially the entire swing of lever 132 taking place while the machine is locked. To bring about this, lever 132 has two lips 131*a* and 131*b* and a central aperture there between. In operation and supposing the parts to be as shown in Fig. 6, wherein the adding lever is in its rearward position and the forward end of lever 132 down, the adding lever may swing until roller 131 has cleared the lip 131*a* and passed the open space in the center and actually come into contact with lip 131*b* before the lever 132 is shifted. The first part of this movement of lever L serves to lock the machine. After striking lip 131*b* roller 131 first gives lever 132 a quick short swing to set it to its upper or subtracting position; this comes about before roller 131 can continue in its movement. After lever 132 has been thus quickly shifted to its upper position, roller 131 can then continue to ride up lip 131*b* without having any effect on lever 132. It is this part of the movement which serves to unlock the machine. The lock mechanism for the adding and subtracting lever comprises swinging plate 185 Fig. 4 to which is rigidly connected the plate 267 and having a rearward corner thereon to swing across the path of block 186 on plate 154 effectually locking the machine.

The total-taking mechanism Figures 4 and 10 includes total lever TL pivotally mounted on rock shaft 163 and connected with adding and subtracting lever L by link 164 which is pivoted to total lever and which is connected to adding lever by slot and pin connection 164^1. Lever L can be swung either forward or backward without disturbing total lever TL but if the total lever is swung downward it necessarily takes with it lever L thereby setting the mechanism in subtracting position, it being understood that in this machine the totaling operation is a partial subtracting operation and includes unreeling or backing out of the calculator wheels, the total of the items previously put in. Total lever TL is slotted at 165 for engagement with the end of link 166, the other end of which is pivoted to rocking cam plate 167, the cam way of which engages roller 168 carried on the lower end of crank arm 169 rigidly mounted on rock shaft 170. Rock shaft 170 carries hooks 171 the rearward ends of which serve as stops, and positioned to be swung around into abutting relation with lugs 80*a*, one of which is carried on the shaft with each calculator wheel 63 and its numeral wheel 64. Lugs 80*a* occupy a space corresponding to one tooth of the numeral pinion, and the parts are so arranged that when hooks 171 are thrown rearwardly lugs 80*a* will bring numeral pinions 63 to rest in correct position. When a total is to be taken since lever L is thrown forward, all the numeral pinions 63 will go into mesh with rack 68 at the beginning of the forward stroke (as for a subtraction) and pinions 63 will then revolve backwards until lugs 80*a* strike hooks 171. This position corresponds to the zero position of the accumulator wheels. Since the number in each accumulator wheel has been eliminated the racks are set at whatever number was registered on the wheels before the operation began. If the numeral wheel should register zero at the beginning of the operation, its lug 80*a* would, of course, already be in contact with the corresponding hook 171 and that rack would not be permitted to start. Thus the total will be backed out of the machine, and at the same time the racks 68 set in position to correspond with the amount of the total and the total printed as the machine is cleared. The accumulator pinions are raised out of mesh on the return stroke of racks 68, so that the completion of the operation will find the total printed and the machine clear.

As a part of the total-taking mechanism there is formed a slot 172 in the total lever plate TL and riding in that slot is a roller

on the end of an arm 173 revolvably mounted on a rock shaft 174 from which shaft a rigidly mounted arm 175 extends rearwardly, Fig. 2, and supports the angle bar 58, whereby, through the action of vertical plate 57, the zero stop of each bank of keys is withdrawn whenever a total or sub-total is to be taken and printed. The arm 173 has lug 173*a* thereon, which engages lug 174*b* on a crank arm 174*a* on shaft 174 when arm 173 is moved in a counter clockwise direction, as viewed in Fig. 4, coiled spring 174*c* acting on shaft 174 normally keeps the arm 175 lowered.

The total-taking mechanism also includes swinging arm 176, having its front face shaped to engage with stud 177 projecting from the outer face of total lever TL, it being the function of this arm to swing on stud 176[1], and induce a swinging movement in the downwardly extending arm 178 which is offset with respect to arm 176, but must move therewith. The lower end of this arm 178 is slotted and cammed to engage roller 179 acting through crank 180 to swing rock shaft 26 (Fig. 3) whereby blade 27 is swung upward against lugs 28 and shifts the releasing plate 20 to withdraw all of the stop-wires so that the stop-noses will not be interfered with by any of the keyboard mechanism, but will be free to swing in response to the setting of numeral wheels, or in other words until the stopping of those wheels by engagement of hooks 171 with stops 80*a*.

While the operator is swinging the total lever from its normal position to its active position, it is desirable that the machine be locked against rotation, and to effect this, there is provided on the lower ledge of total lever plate TL, cam 181 which rolls over a roller carried on bell crank 182 working against the tension of spring 183 and serving to swing the lower arm of that bell crank against roller 184 projecting from the side of stop-plate 185. When the operator starts to swing the total lever back, cam 181 rides up on roller and swings plate 185 downward into the path of stop-plate 186 carried on the side of main control plate 154, which acts as a brake thereby locking the machine against rotation until after the total lever has reached substantially its forward or working position and thereby has swung its cam 181 beyond the roller plate 182 far enough to permit locking plate 185 to move upward again to the clear position.

The lower edge of total lever plate is cut away at 187 so that the shoulders thus formed can act in conjunction with shaft 189 (which carries lever 132) to limit the swing of the total lever.

The sub-total STL is of the shape shown in Fig. 9 and has its lower edge provided with a cam face 190 so that it can also serve to swing bell crank 182 and force locking plate 185 into position in front of main control plate. But this projection 190 on the sub-total lever has an additional function, in that it may swing rearward to lie over arm 191 projecting forwardly from swinging plate 141; thereby acting to prevent that plate from swinging, irrespective of a shift in the tension device. Thus in taking a sub-total, the numeral wheels are thrown into mesh with the segmental racks and run along until stopped, but are not lifted out of mesh on the return stroke. They must run back over the same distance and thereby take up again the total which they had just given up to the printing mechanism. In other words this projection 190, co-operating with arm 191, insures the retention in the calculator of the total, which has been printed out, in this respect differing from the operation when total lever TL only is depressed, for in that case the total is printed out and the machine is cleared.

The sub-total lever is connected with total lever TL through stud 193 which strikes against an inwardly projecting extension of stud 177, so that although the total lever can be pulled forward without disturbing the sub-total lever, it is not possible to pull the sub-total lever without also swinging the total lever with it. It is this forward swinging of the total lever that sets all of the various total-taking mechanism and it is the forward swing of the sub-total lever that so locks swinging plate 141 as to insure return of the total into the calculating wheels.

Referring now to Figs. 2 and 5, these illustrate the slip joint. This joint is situated between the main rock shaft 69 and stop-nose arms 70 and segmental rack arms 68 and comprises a series of spools 89 and collars 90 which have keyways to receive feather 91 on shaft 69; these spools and collars can slide along the shaft but must always turn with it. On one side of each collar is type-bearing lever 92 running back to the rear end of the machine and carrying the removable type head corresponding with one of the

key sections; the other end of that lever constitutes arm 70 which carries at its front end the stop-nose whereby the swing of the segmental rack is regulated. On the other side of that collar is the segmental rack arm 68.

The connection between each collar and its co-operating arms 92 and 68 is effected by means of flanges, one carried by the collar and the other carried by the adjacent spool so that these arms need not come in direct contact with main rock shaft 69. To insure perfect wearing and perfect surface, each of swinging arms 92 and 68 is faced on both sides with babbitt disks 92^1 and 68^1 cast in place and accurately surfaced before the machine is assembled. Small holes may be drilled through the arms so that the cast disk on one face will be intimately connected with the cast disk on the other face. To insure uniform wear and lubrication, rock shaft 69 is made hollow and provided with an oil feed at one end and with radial ducts leading out to an oil groove at each slip joint.

To insure a constancy in the slip and a uniform tension on the various parts of the slip joint, there is provided at one end of the rock shaft helical spring 93 which is coiled about the rock shaft and presses directly against the end disk, this pressure being transferred across from one collar or spool to the next, the series terminating in disk 94 permanently pinned to the shaft. Spring 93 is housed in box 93^1 (see Fig. 2) and on assembly is adjusted to proper tension, which never need be changed in normal use. By these means the type bearing levers are checked at the end of their return movement while the rock shaft completes its return movement.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A calculating machine provided with a reversing lever or the equivalent having mechanism associated therewith comprising a quick action release for snapping a totalizer pinion into or out of mesh with a differential actuating rack while the rack is at the beginning or end of its forward swing, whereby subtraction or addition can be effected substantially as described.

2. A calculating machine according to Claim 1 provided with a control lever device for said reversing lever and connections between the two so that the device may move from the position corresponding to either setting of the reversing lever, substantially to a position corresponding to the other setting of the lever, without disturbing the reversing lever, the machine being locked during the shifting of the said reversing lever.

3. A calculating machine according to Claim 2 wherein the totalizer pinions are meshed with the racks by a spring tension snapping device preferably actuated by a controlling plate which is itself actuated by a main drive shaft, the tension device being associated with releasing mechanism co-operating with the controlling plate to shift the pinions with respect to their racks at the proper moment.

4. A calculating machine according to Claim 1 to 4 in which the totaling elements comprise means movable into position for engagement by stop devices on the numeral pinions, which pinions are snapped into engagement with the actuating racks at the beginning of the swing thereof, the stop-wires being withdrawn by means of a bell crank lever one arm of which engages a pin on the total lever the other arm actuating a rock shaft carrying a blade that is adapted to shift a releasing plate so that the control of the racks is shifted from the stop-noses to the stop devices and the racks are set to a position corresponding to the total while the machine is cleared.

5. A calculating machine according to Claims 1 to 5 wherein the differential actuating rack arms are mounted between a pair of friction members on a main rock shaft, the said members being yieldingly forced together.

6. A calculating machine according to Claim 5, in which each of the said actuating racks is associated with a lever carrying type at one end and a stop-nose at the other end both supported by the said rock shaft, a friction connection being also provided between the rock shaft and the lever, for the purpose specified.

7. A calculating machine according to Claim 7 wherein the support for the type-bearing lever is swung to swing said lever and its type and also the rack arm, the arrangement being such as to ensure a constancy in the slip and a unifform tension in the movement of the type-bearing lever which is retarded or checked at the end of its return movement while

the rock shaft completes its movement, for the purpose specified.

8. A calculating machine according to Claims 6 to 8 wherein the type-bearing lever and the rack arm are carried between spools and a collar and are yieldingly held by babbitt or like discs so as to swing with the rock shaft, substantially as described.

9. The calculating machine having its parts constructed and adapted to operate substantially as herein described with reference to the accompanying drawings.

Dated the 17th day of January, 1920.

For The TEETOR COMPANY,

White Langner Stevens & Parry,
Chartered Patent Agents,
Jessel Chambers, 88–90, Chancery Lane,
London, W.C.2., and
Liberty Tower, 55, Liberty Street,
New York, U.S.A.

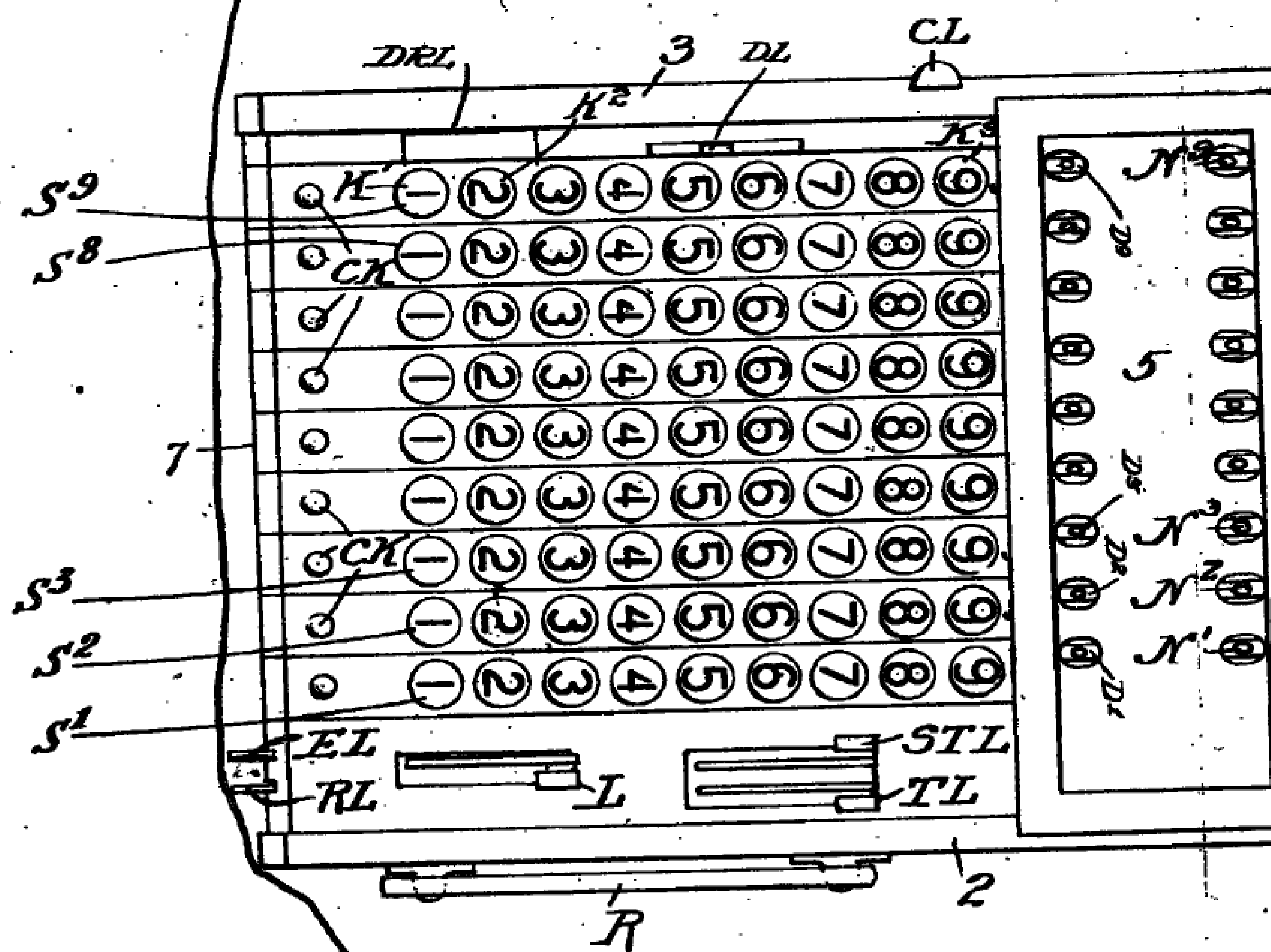
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Fig. 1.

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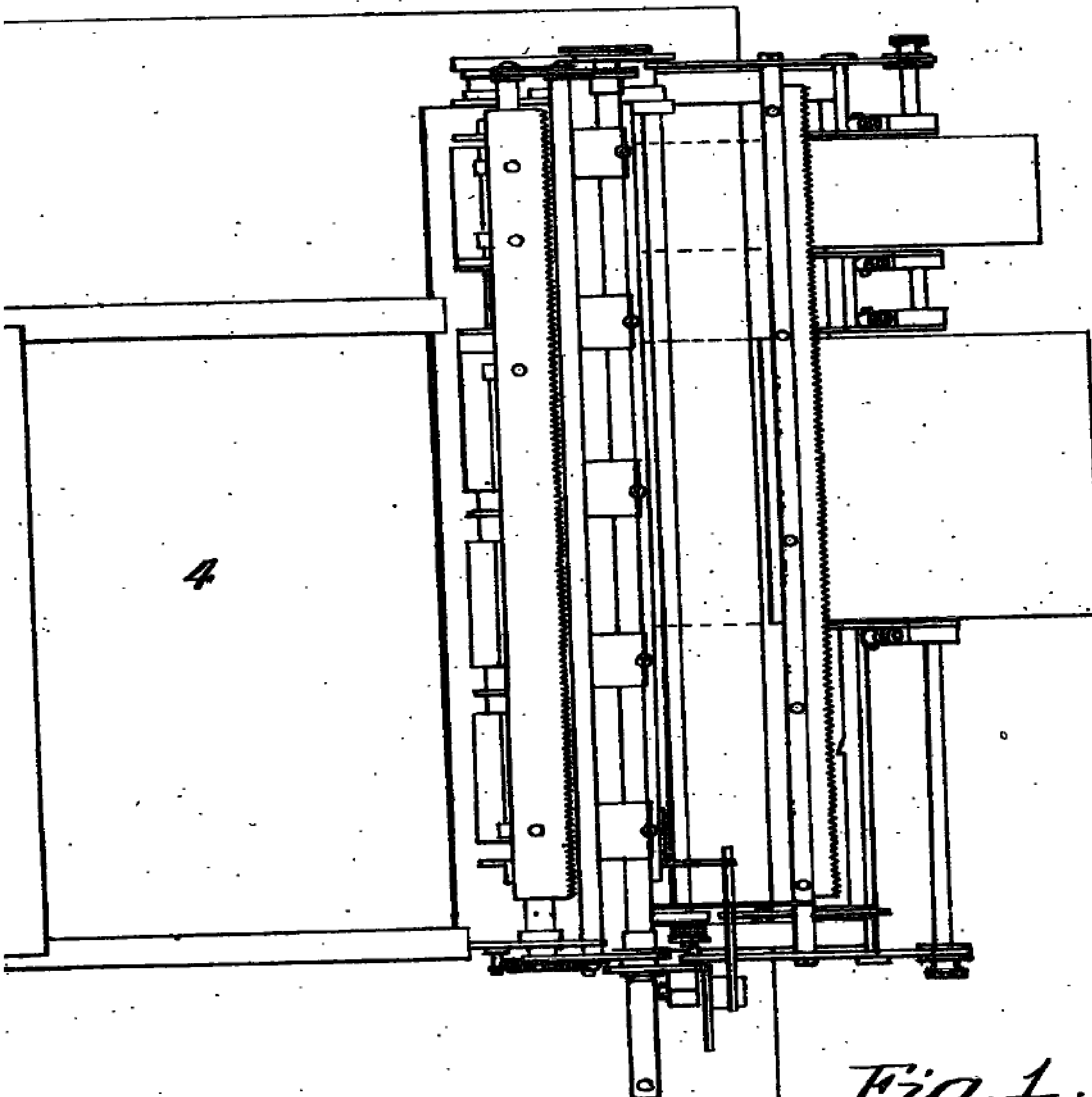
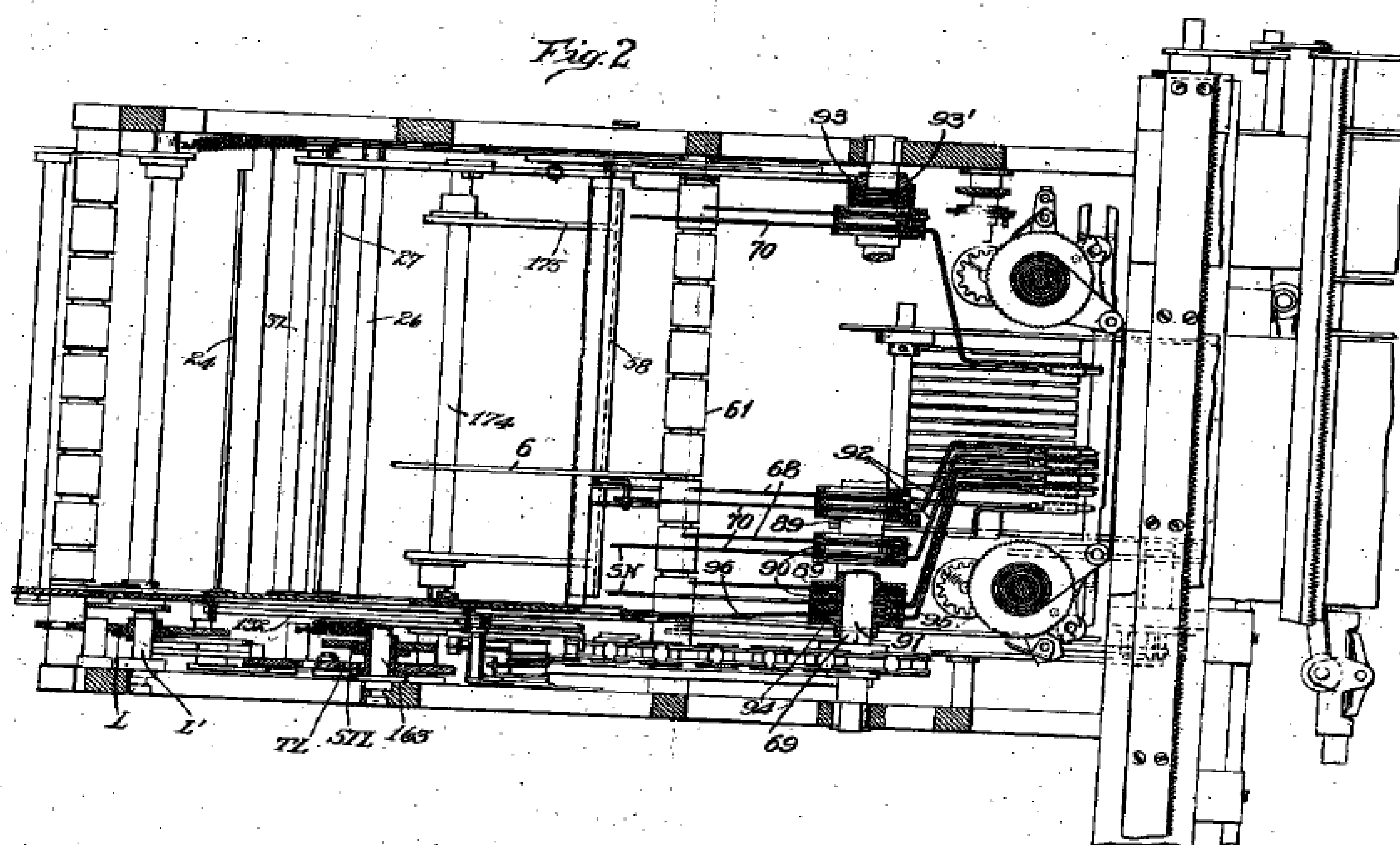


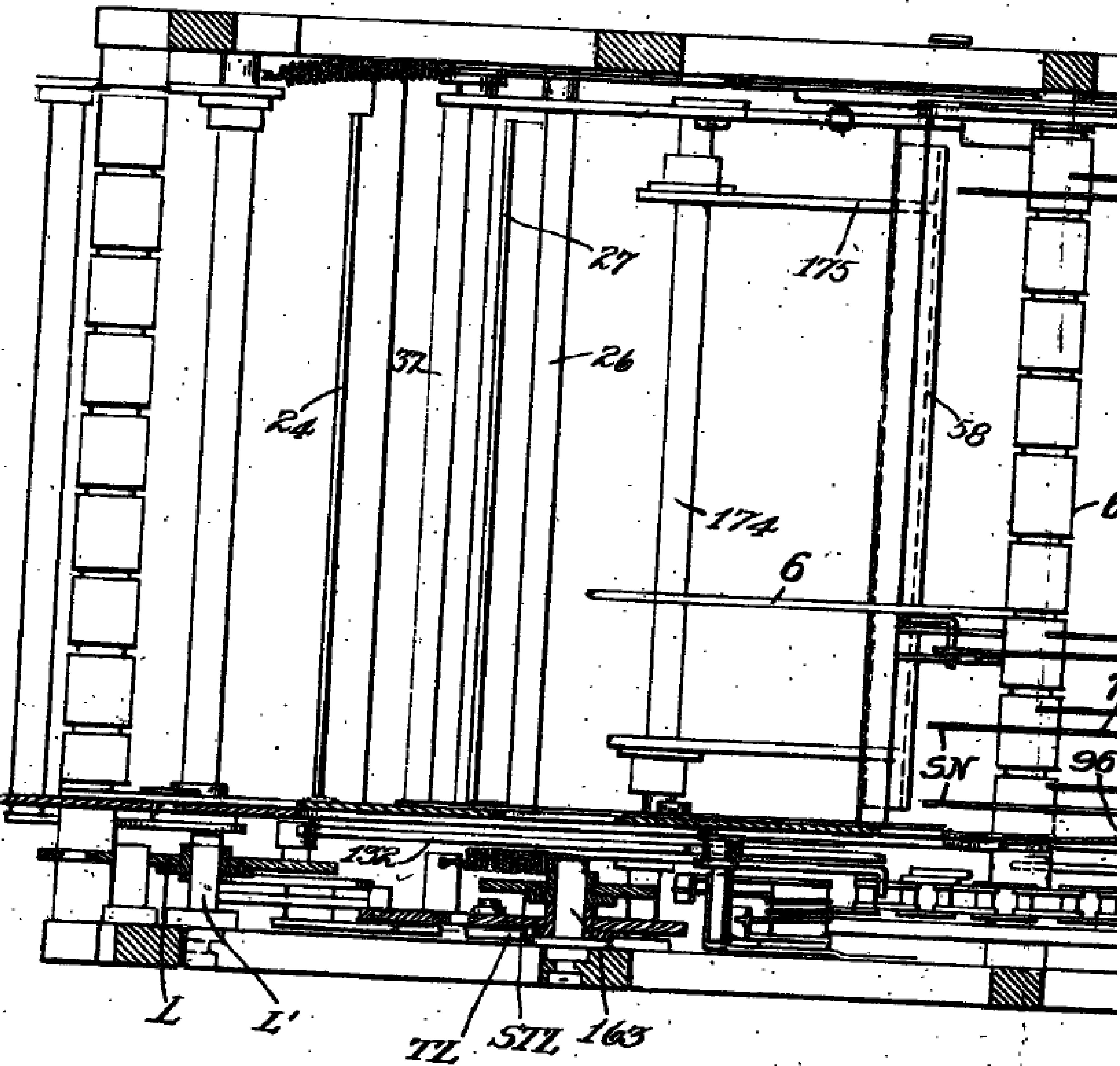
Fig. 1.

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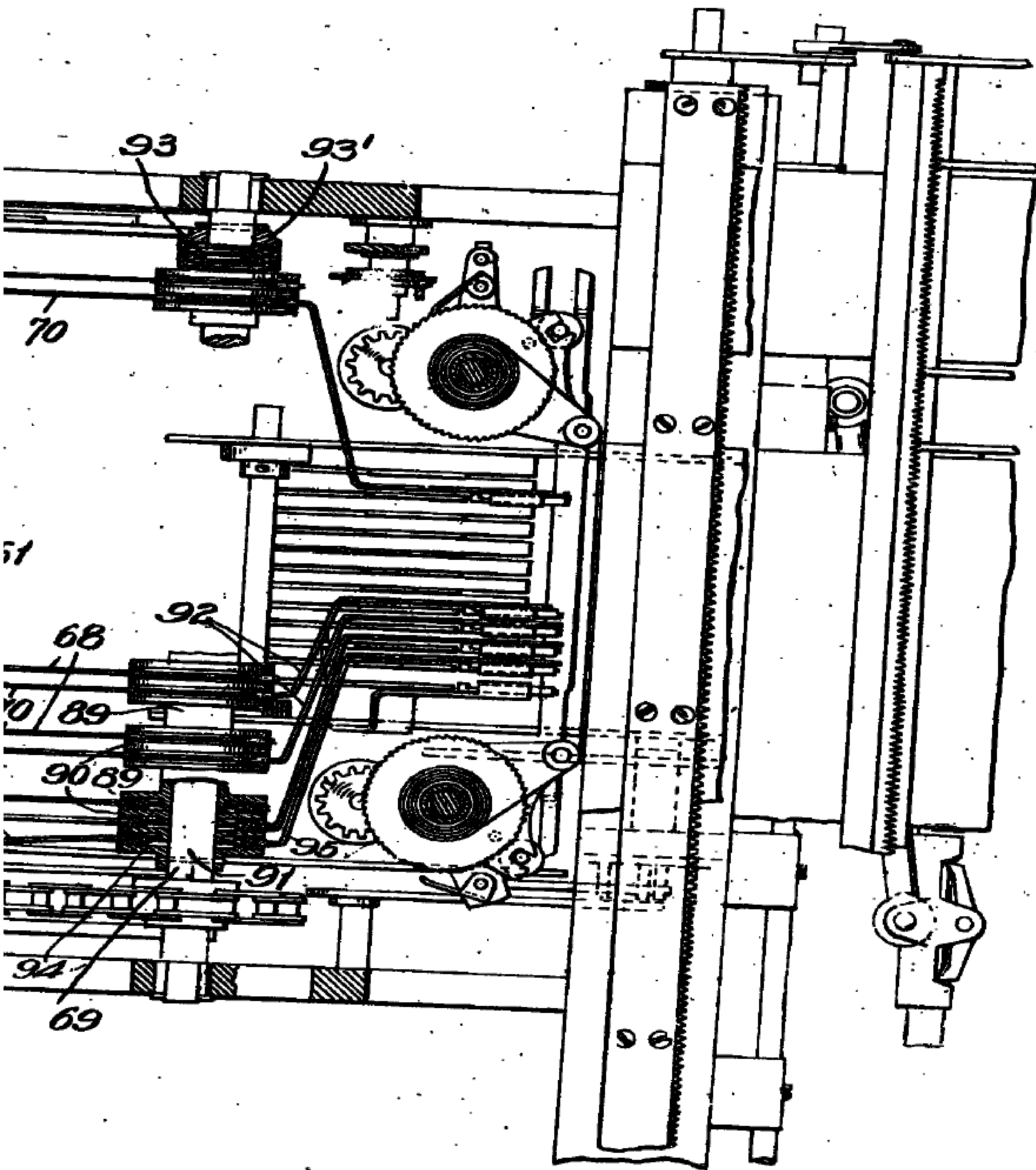
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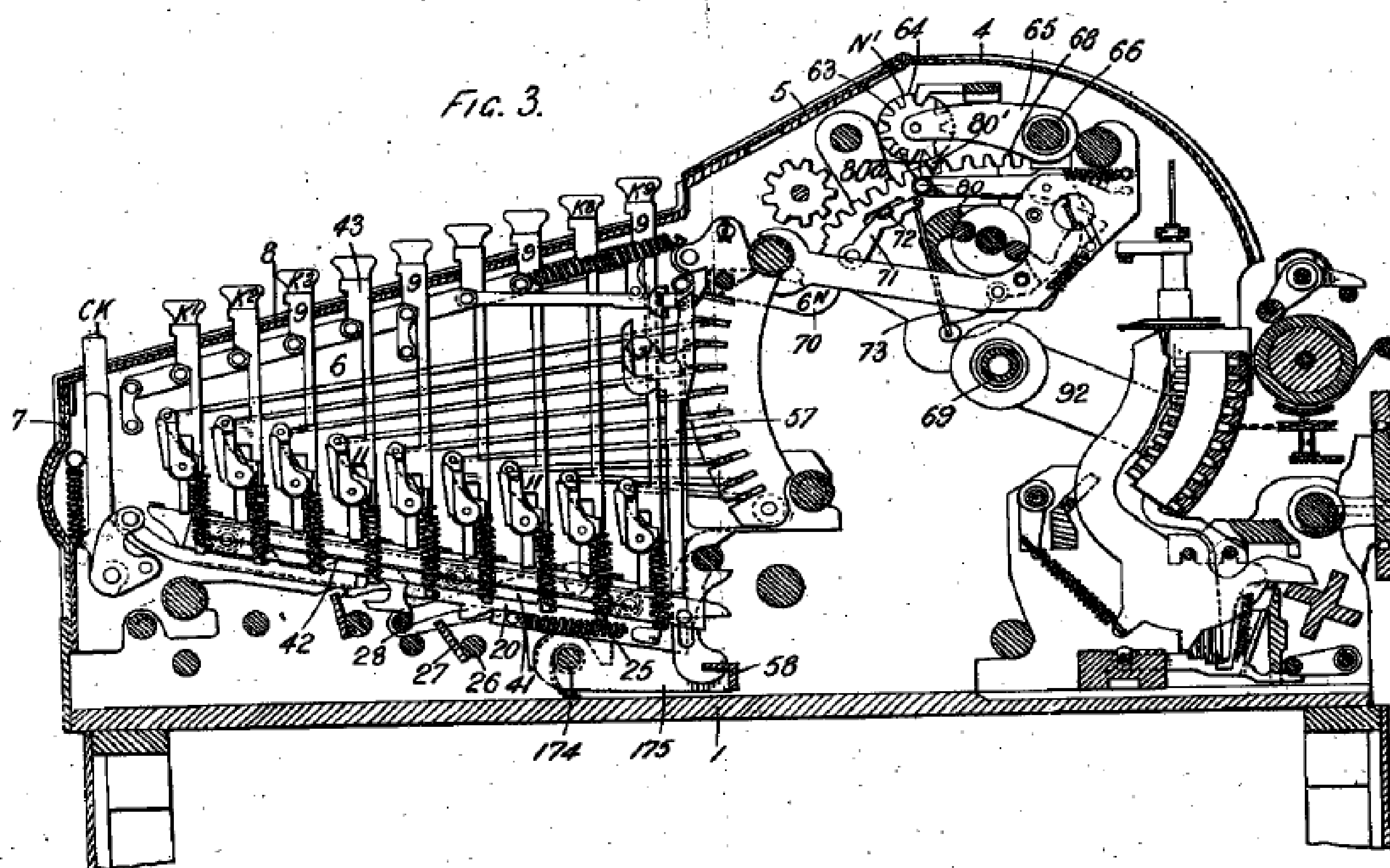
5 SHEETS
SHEET 2



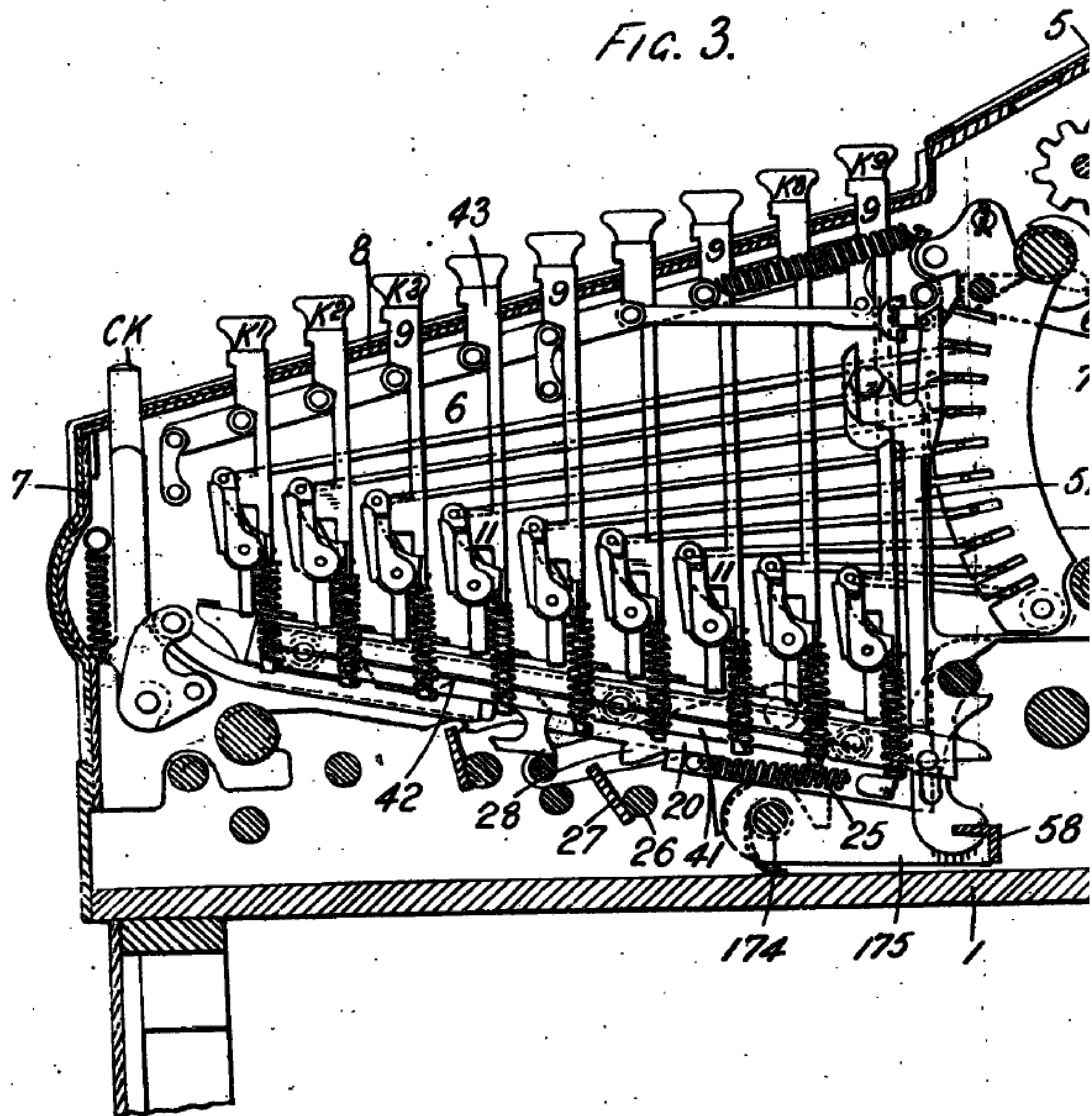
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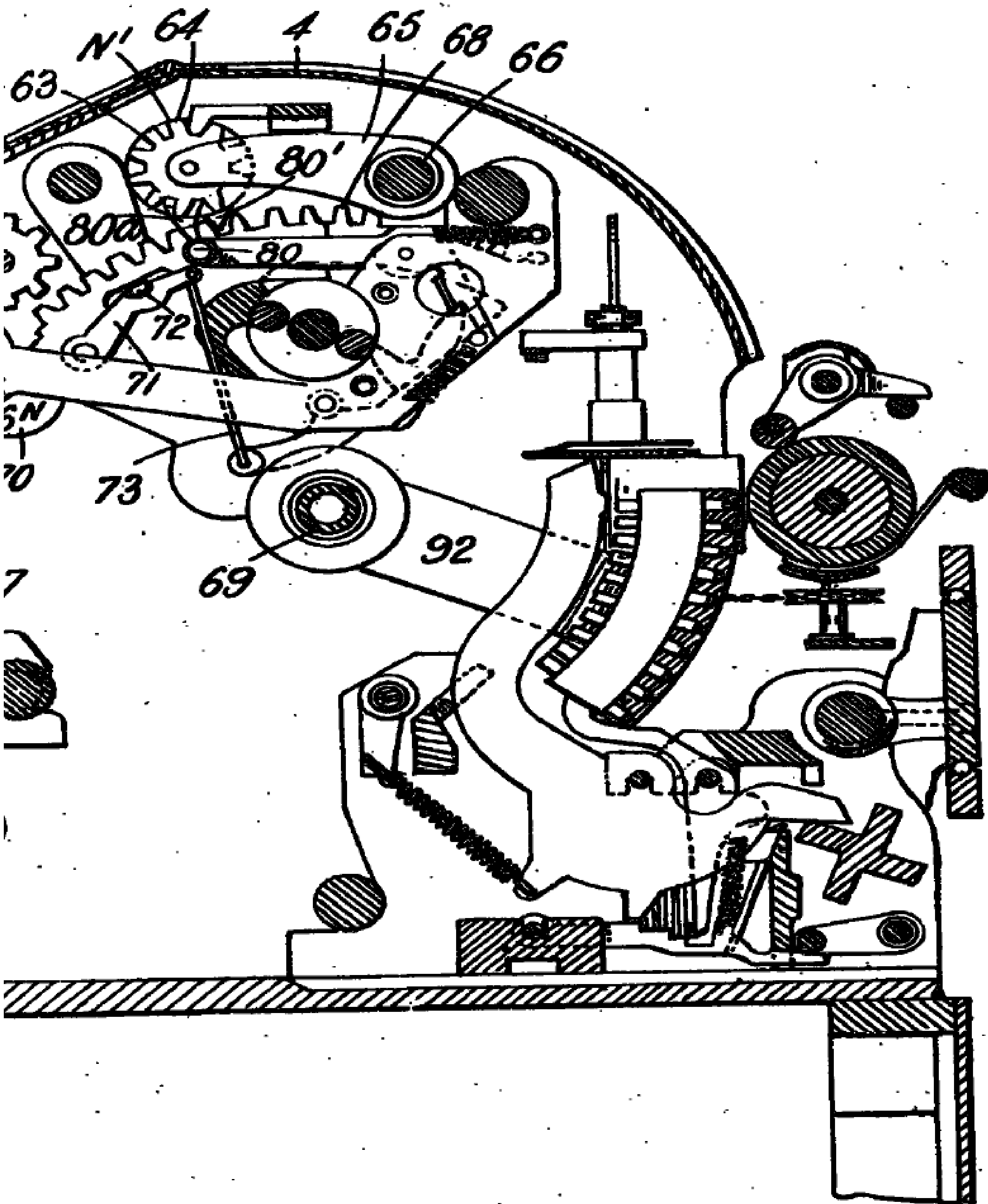
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SHEET 3



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FIG. 9.

FIG. 10.

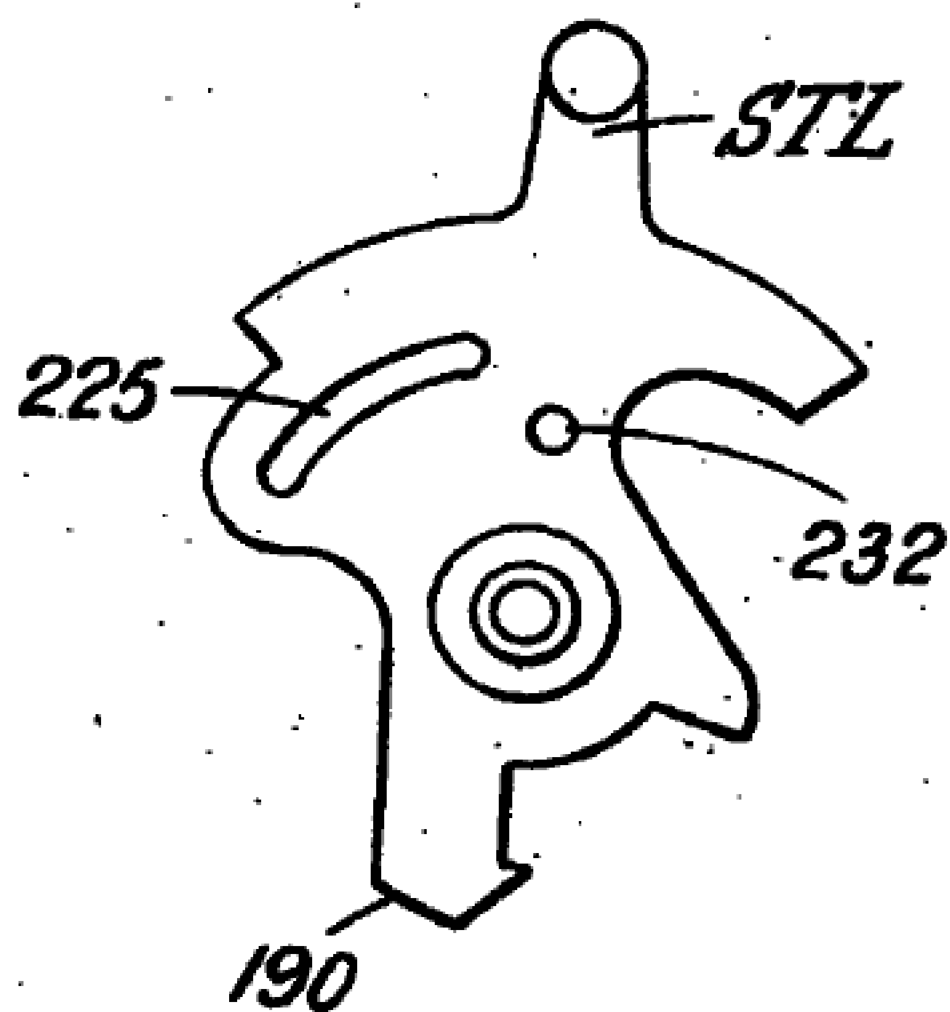
FIG. 4.

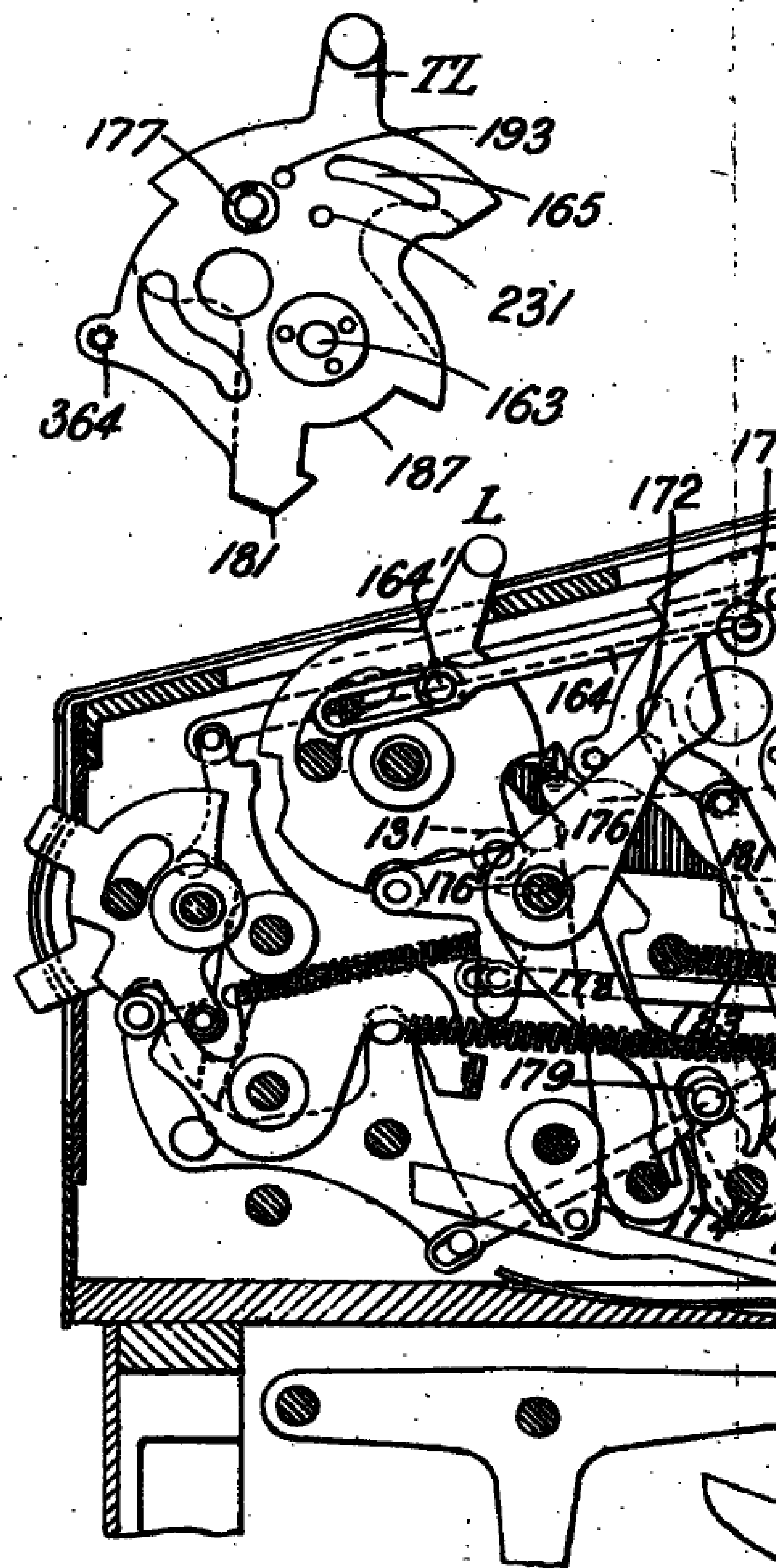
FIG. 5

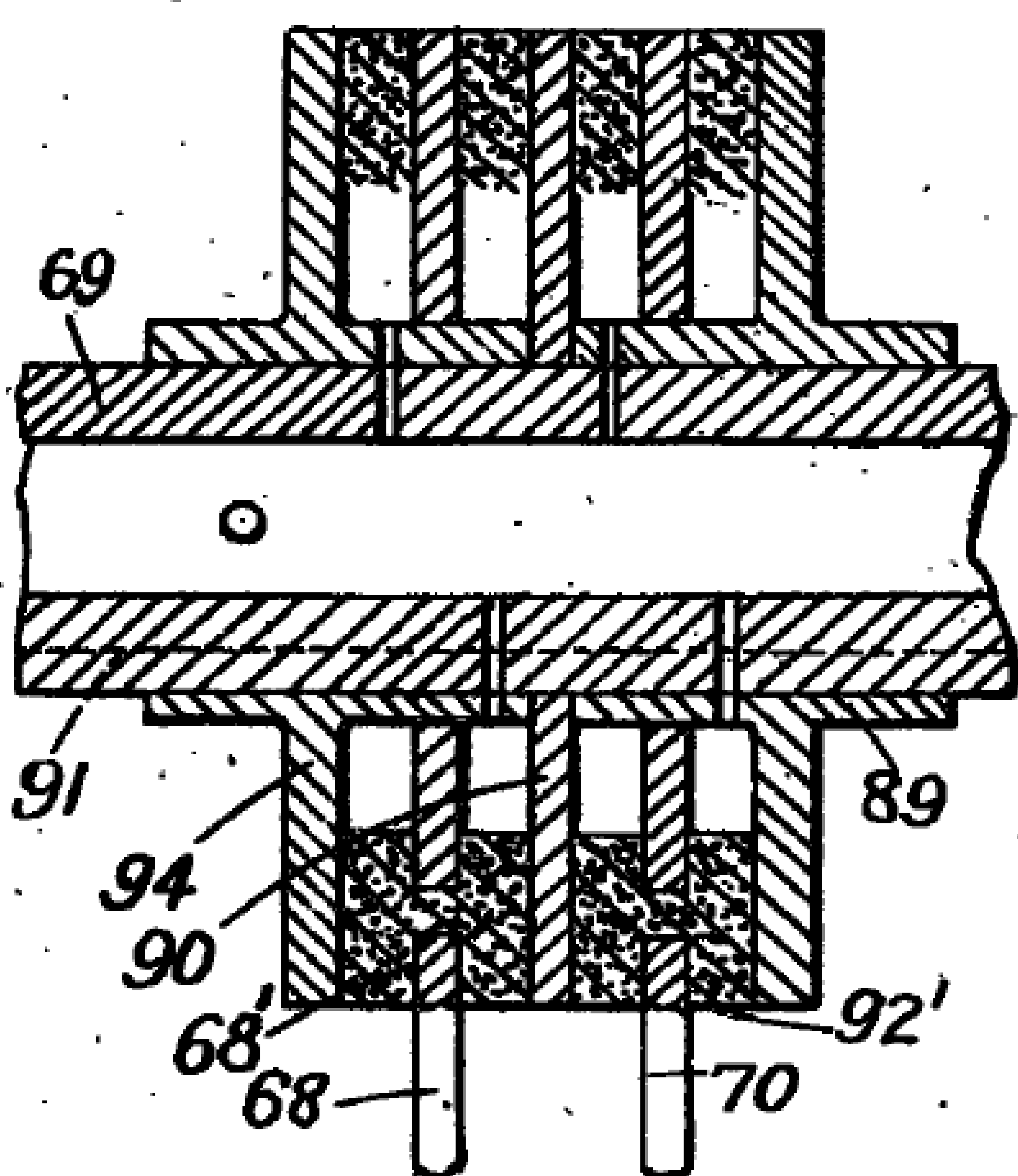
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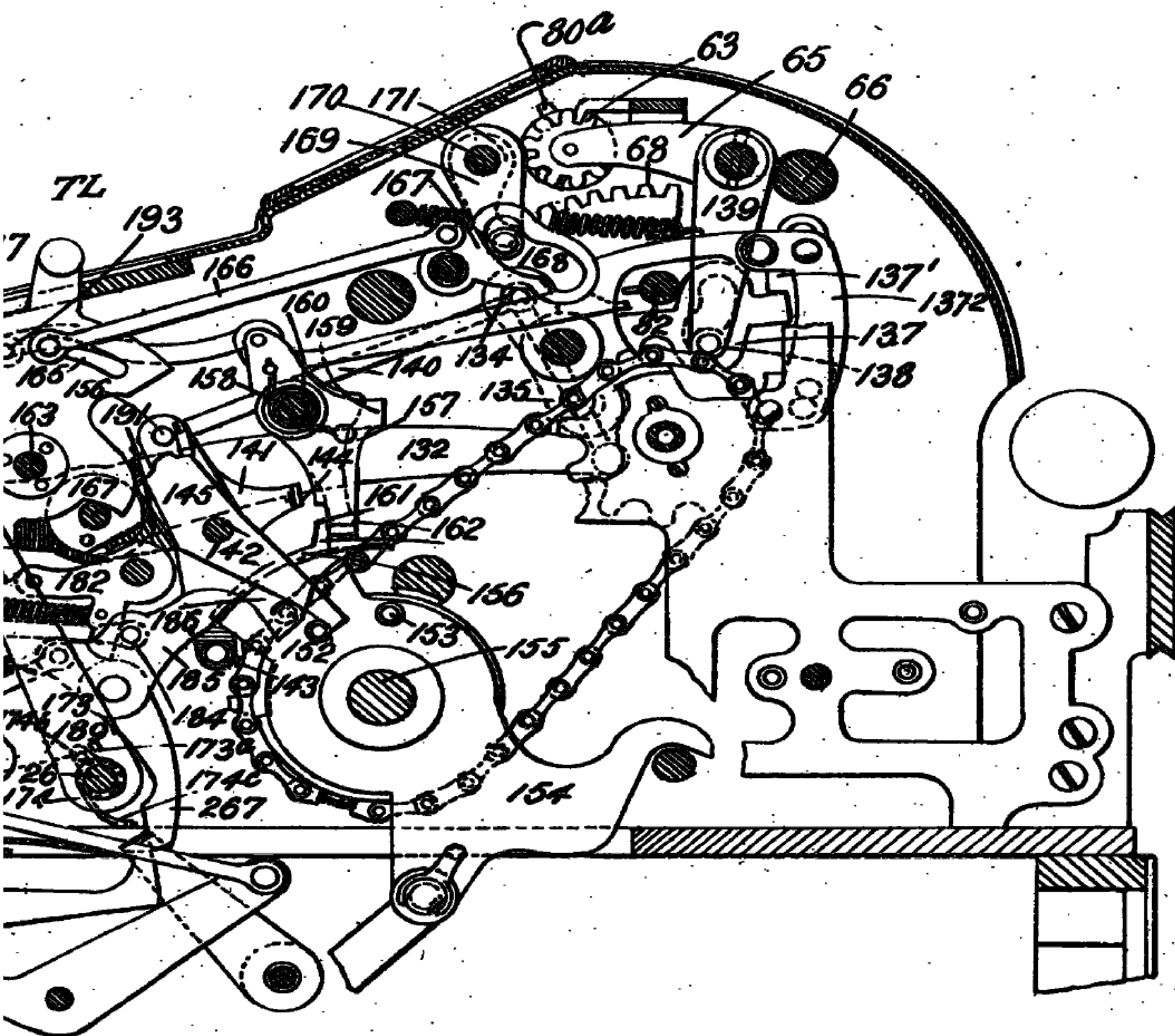
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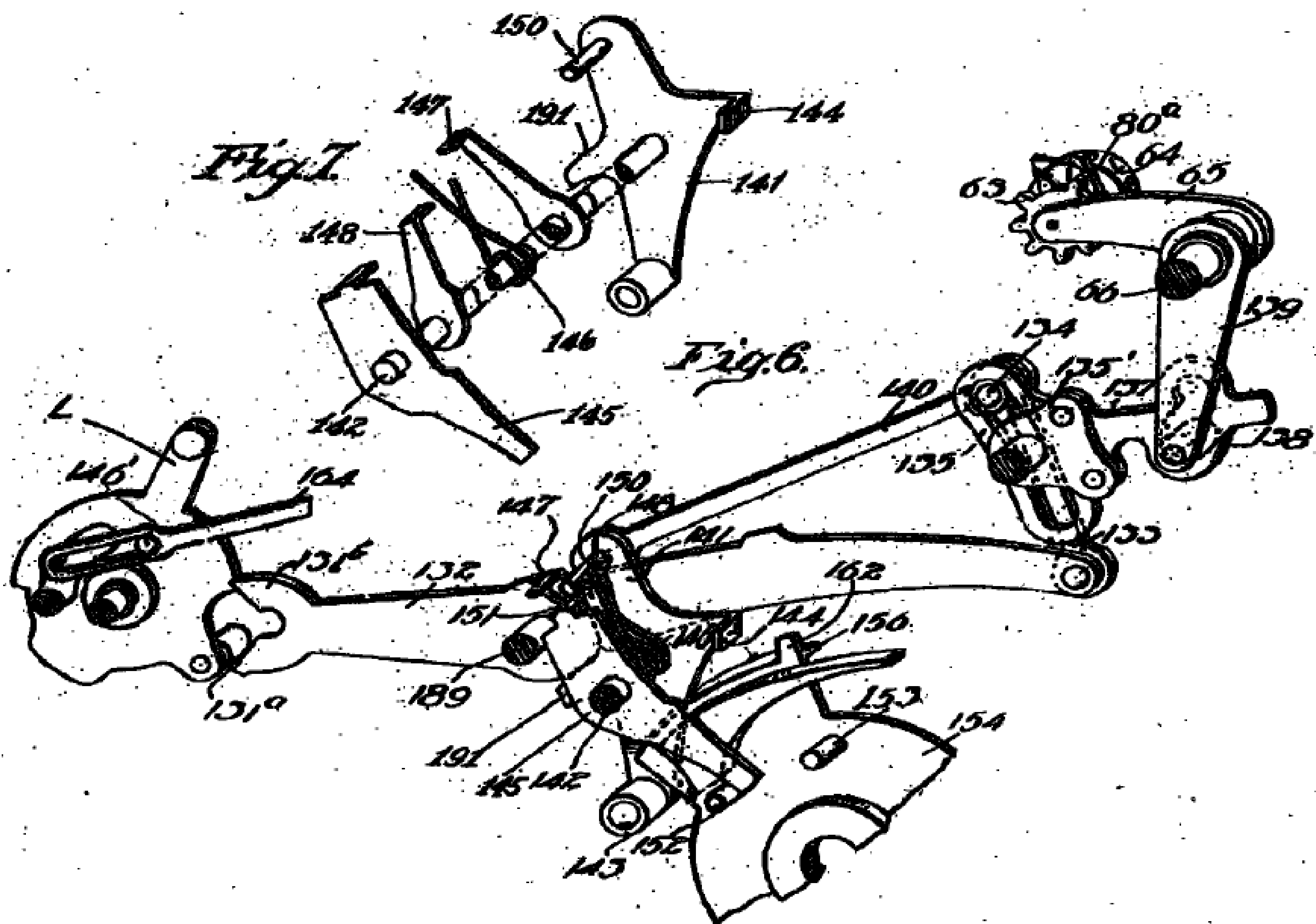


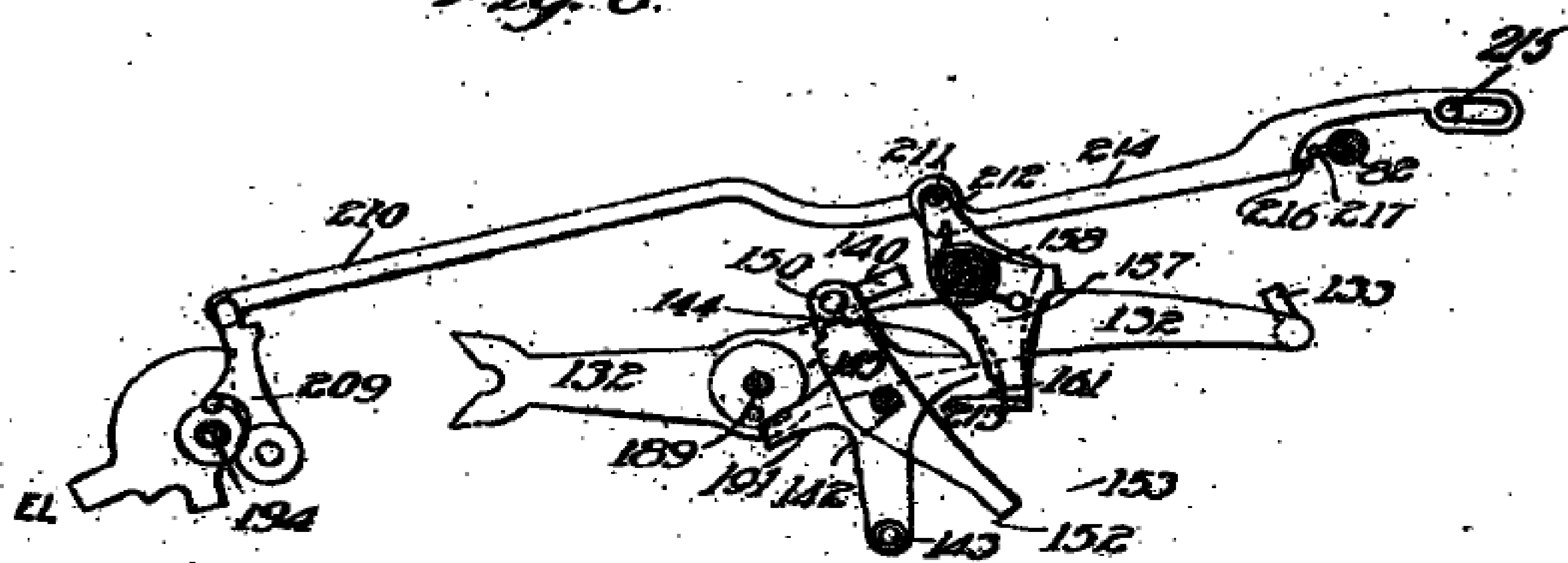


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NEXT ITEM

Erratum au brevet n° 534.050.

Le nom de la Société demanderesse étant erroné, il faut substituer les lignes suivantes à celles qui sont placées dans le titre, à la fin de la description, sur les quatre planches.

1° Rectification du titre :

Société dite : THE TEETOR COMPANY résidant aux États-Unis d'Amérique.

2° Rectification de la signature :

Société dite : THE TEETOR COMPANY.

3° Rectification sur les quatre planches :

Société dite : The Teetor Company.

Société dite : The Teetor Company.

Société dite : The Teetor Company.

Société dite : The Teetor Company.

RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

XII. — Instruments de précision, électricité.

3. — POIDS ET MESURES, INSTRUMENTS DE MATHÉMATIQUES, COMPTEURS ET PROCÉDÉS D'ESSAI.

N° 534.050

Perfectionnements apportés aux machines à calculer.

Société dite : THE TECTOR COMPANY résidant aux États-Unis d'Amérique.

Demandé le 28 mai 1920, à 15h 7m, à Paris.

Délivré le 26 décembre 1921. — Publié le 16 mars 1922.

(Demande de brevet déposée aux États-Unis d'Amérique le 18 avril 1914. — Déclaration du déposant.)

La présente invention se rapporte à des machines à calculer dont les caractéristiques vont être exposées en détail ci-après, à l'appui des dessins qui représentent une forme d'exé-
5 cution de la machine, employée de préférence, et dans lesquels :

La figure 1 est un plan de la machine, dont une partie de la plateforme de support est supposée arrachée, à l'avant.

10 La figure 2 est une coupe transversale par le clavier et le mécanisme accumulateur, montrant le mécanisme du marteau en élévation latérale, et supprimant la plus grande partie de la platine, du chariot et de l'avance-
15 ment du ruban.

La figure 3 montre, à plus grande échelle, une coupe du clavier, dont une partie des pièces est enlevée.

La figure 4 est une vue de détail de l'étrier
20 oscillant et de la selle qui établissent la liaison entre chaque tige de touche et sa tringle d'arrêt.

La figure 5 est une coupe transversale par l'une des plaques porte-touche.

25 La figure 6 est une vue perspective du mécanisme qui commande la tringle d'arrêt du zéro.

La figure 7 est une coupe horizontale par la figure, immédiatement au-dessus de la
30 plaque coulissante 20.

La figure 8 est une coupe transversale prise directement à l'intérieur de la plaque de droite.

La figure 9 montre les organes de commande placés du côté gauche de la machine.

35 La figure 10 est une vue perspective du levier L et de l'engrenage inverseur qu'il commande et grâce auquel la machine est transformée de machine à additionner en machine à soustraire.

40 La figure 11 est une vue de détail du dispositif tendeur représenté au milieu de la figure 11.

La figure 12 est une élévation latérale du levier éliminateur, comprenant ses connections
45 qui traversent de part en part, en vue de coopérer avec certains organes indiqués à la figure 11 et destinés à maintenir hors d'action le mécanisme de réserve en permettant au mécanisme imprimeur d'enregistrer, par
50 exemple, un numéro de facture.

La figure 13 est une vue de détail du levier sous-totalisateur.

La figure 14 montre les liaisons entre le levier sous-totalisateur et le levier totalisateur.

55 La figure 15 est une élévation latérale d'une division du mécanisme de réserve montrant le système d'encliquetage qui règle l'échappement entre le bec d'arrêt et sa crémaillère et commande de ce fait le transfert
60 ou report d'une division à la suivante.

Prix du fascicule : 1 franc.

La figure 16 est une vue de face du mécanisme de la figure 15, partiellement en coupe, et vu dans le sens des flèches de la figure 15.

La figure 17 est une coupe horizontale représentant en plan l'arbre oscillant principal et les bras porte-caractères oscillants, de même que certaines autres pièces.

La figure 18 est une vue de détail, en coupe, du joint à glissement au moyen duquel les becs d'arrêt et les crémaillères oscillantes sont rabattus vers l'extérieur de l'arbre oscillant principal.

Fonctionnement général (figure 1). — Les touches du clavier sectionné sont groupées suivant la pratique courante. On a représenté neuf séries de touches, mais on peut en employer plus ou moins s'il est requis. Ces neuf divisions sont indiquées par les lettres S^1, S^2, etc., jusqu'à S^9. Quand on retire l'une quelconque de ces divisions, pour une visite ou une réparation, on enlève en même temps une partie du mécanisme intérieur de la machine, sans toutefois déranger les autres divisions, ni amener aucun changement matériel à l'intérieur du corps de la machine.

Au-dessus du clavier se trouve une fenêtre ou une série de fenêtres, par lesquelles on peut voir les roues compteuses N^1, N^2, jusqu'à N^9 et, de préférence, à une certaine distance au-dessous de celles-ci, des roues D^1, D^2, à D^9, étant entendu que les roues N^1, etc., font parties du mécanisme calculateur et que l'ensemble du mécanisme calculateur peut, à un moment quelconque, être contrôlé par là, tandis que les roues D^1, D^2 à D^9 sont les roues du duplicateur destinées à retenir un nombre quelconque ayant servi dans les calculs effectués sur la machine.

Sur le bord de droite du clavier se trouve le rail de mise en marche R dont les liaisons sont telles que l'opérateur peut le toucher par le bord de la main sans que les doigts quittent le clavier.

Quand le rail est ainsi touché le moteur de commande est mis en liaison active avec la machine et il fait tourner cette dernière pendant une course complète, à moins que le rail de mise en marche ne soit maintenu abaissé de manière à répéter l'opération.

A la droite de la machine également, se trouve le levier L qui peut être rabattu soit en arrière, soit en avant, enclenchant ainsi la machine respectivement pour additionner ou pour soustraire. Par exemple, si l'on désire porter un nombre déterminé sur la machine dans le sens positif ou d'addition, on rabat le levier L vers l'arrière de la figure 1, soit avant, soit après la frappe du clavier, puis l'opérateur frappe le rail R, abaissant l'embrayage qui relie le moteur électrique à l'arbre de commande, et faisant ainsi tourner les roues du calculateur en vue d'inscrire le nombre qui avait été frappé sur le clavier. En même temps ce nombre s'imprime sur le rouleau ou la feuille de papier, à l'arrière, la platine est poussée de manière à faire avancer le papier, et le ruban est déplacé en vue de présenter une surface fraîche, de même que d'autres opérations accessoires sont exécutées automatiquement.

Un nouveau nombre frappé sur le clavier peut, d'une manière similaire, être reporté sur les roues compteuses qui, par leur rotation, additionneront ce nombre au total déjà indiqué par les roues, en même temps que ce deuxième nombre s'imprimera sur le papier à l'arrière de la machine.

Normalement le mécanisme imprimeur et le mécanisme du chariot sont toujours en liaison active, en sorte que tout nombre frappé sur le clavier et reporté sur les roues compteuses sera imprimé simultanément pour fournir un contrôle permanent.

D'autres nombres peuvent être additionnés successivement, chaque nombre servant à faire tourner d'une nouvelle quantité les roues compteuses, et par conséquent à établir le total.

Pour retrancher un nombre soit d'un autre, soit du résultat total d'additions ou de soustractions précédentes, on rabat en avant le levier de commande L, soit avant soit après avoir frappé le nombre sur le clavier, après quoi le rail R en s'abaissant fera de nouveau tourner la machine, mais cette fois, les roues compteuses tourneront en arrière d'une quantité correspondante à la frappe du clavier, ce qui aura pour résultat de soustraire mécaniquement le nombre inscrit.

Les nombres à soustraire sont également imprimés, mais le bâti du chariot doit d'abord être renvoyé en arrière à une distance suffisante pour imprimer dans une colonne séparée le nombre soustrait, afin que les nombres

additionnés soient imprimés dans une colonne et que les nombres retranchés soient imprimés dans une colonne voisine. Néanmoins, il est possible d'imprimer à la fois les nombres additionnés et les nombres soustraits, soit dans la colonne d'addition, soit dans la colonne de soustraction ; il suffit à cet effet de manœuvrer un loquet C L du chariot qui a pour fonction de caler ce dernier contre tout mouvement, en sorte que, s'il est enclenché dans l'alignement de la colonne d'addition, il continuera à être arrêté à cette colonne, soit que les nombres soient ajoutés ou retranchés sur les roues compteuses, et de même, bien entendu, si le chariot est enclanché dans la position de soustraction, tous les nombres seront inscrits les uns à la suite des autres dans la colonne de soustraction quand même quelques-uns d'entre eux seraient des nombres effectivement additionnés sur les roues compteuses.

A un instant quelconque du fonctionnement, il est possible d'opérer la soustraction d'un nombre qui a été additionné par erreur (ou inversement, d'additionner un nombre soustrait par erreur) sans qu'il soit besoin de ramener le chariot à la colonne opposée, avant de faire la correction. Il suffit pour cela de pousser le loquet C L du chariot et de maintenir ce dernier dans la position qu'il occupait au moment où le nombre erroné a été porté sur la machine.

Afin d'identifier définitivement des nombres négatifs, soit qu'ils aient été imprimés d'eux mêmes dans une colonne, soit qu'ils soient mêlés à des nombres positifs, un caractère ou une marque appropriée s'imprime à côté du nombre, par exemple le signe «moins», lequel s'imprime automatiquement chaque fois que l'on fait une entrée négative, sans qu'il soit besoin d'aucune manipulation spéciale de l'opérateur.

Etant donné que les roues compteuses sont manœuvrées dans le sens positif quand le levier L est rabattu pour l'addition, et dans le sens inverse ou négatif quand le levier L est rabattu pour la soustraction, les indications des roues compteuses, lues aux fenêtres, donneront toujours la somme arithmétique des nombres entrés dans la machine depuis sa dernière mise au point, à l'exclusion de tout «nombre éliminé», dont il sera fait mention plus loin.

Pour prendre un total ou pour imprimer un total sur la feuille d'enregistrement, l'opérateur abaisse le levier totalisateur T L, déplaçant par là le mécanisme de manière que le total porté sur les roues compteuses soit extrait desdites roues à la première rotation de la machine, ramenant en même temps les roues à leur position zéro, après quoi elles cessent d'être en prise avec les crémaillères qui les commandent et ces dernières reviennent à leur position normale. Après cette manœuvre, toutes les roues compteuses se trouvent dans leur position initiale ou au zéro. Ce retrait ou arrêt des roues compteuses sert à faire inscrire par le mécanisme imprimeur, le nombre total extrait des roues.

Pour faire subsister le total sur la machine (ce qui s'appelle communément «sous totaliser»), il faut que le levier sous totalisateur S T L et le levier T L, soient amenés chacun à sa position la plus basse. Ces deux leviers sont enclenchés de telle sorte que, tandis que T L peut être abaissé sans déplacer S T L, il n'est pas possible de pousser S T L de haut en bas sans entraîner T L. Si les deux leviers S T L et T L sont dans leur position inférieure, la machine, mise en marche par l'abaissement du rail R, extraira le total des roues compteuses en faisant inscrire ce total par le mécanisme imprimeur, puis, tout en maintenant les roues engrenées, elle ramènera ces dernières à leur position précédente, c'est-à-dire que la machine gardera son total enregistré.

Dans bien des machines, on juge nécessaire de caler le clavier ou les touches dans une position fixe quand il s'agit de prendre un total ; sinon, la machine pourrait soit imprimer un total faux, soit se dérégler. Dans la présente machine, on ne cale pas le clavier et malgré cela le total ne peut être faussé et l'opération de la totalisation ne dérègle pas la machine. On obtient ce résultat en rabattant en avant les tringles d'arrêt du mécanisme des touches en leur faisant quitter la position d'arrêt par l'intermédiaire d'un arbre à bascule relié par des connections appropriées au levier totalisateur T L, en sorte que, quand ce levier est poussé en avant à sa position de totalisation, les tringles d'arrêt sont en dehors du passage des organes oscillants de l'intérieur de la machine. Bien que les touches ne soient

pas calées contre tout mouvement, elles sont mécaniquement isolées du reste de la machine pendant la totalisation, et aucune d'elles ne peut avoir d'action sur le total ni gêner les organes oscillants.

Il est parfois commode et même nécessaire d'entrer un nombre sur la feuille à imprimer sans l'ajouter sur les roues compteuses, par exemple s'il y a lieu d'inscrire le numéro d'un wagon ou d'une facture, ou quelque autre donnée d'identification, à titre d'explication des nombres effectifs à additionner ou à soustraire. Afin de permettre d'imprimer des unités explicatives de ce genre sans agir sur les roues compteuses, on a établi à l'avant de la machine un levier éliminateur E L qui sert à éliminer ou maintenir hors du mécanisme compteur les nombres explicatifs qui doivent être imprimés sur la feuille d'enregistrement permanente. La position inférieure du levier E L constitue sa position normale ou inactive, et, quand il est levé, il se trouve dans la position requise pour entrer sur la feuille imprimée le nombre frappé sur le clavier, sans toutefois que cette frappe puisse agir sur les roues compteuses. Chaque fois qu'un de ces nombres explicatifs ou d'identification est imprimé sur la feuille, un signe explicatif s'imprime simultanément et automatiquement sous la forme d'une marque spéciale qui suit le nombre, et le dit signe suffit à indiquer que c'est le numéro d'un wagon ou d'un bulletin de chargement ou de leur analogue, et que ce n'est pas l'un des nombres additionnés ou soustraits par le mécanisme compteur.

On a également prévu un mécanisme à répétition, en sorte que le même nombre peut être entré plusieurs fois successivement sans qu'il soit nécessaire de frapper le clavier à chaque opération. On obtient ce résultat au moyen d'un levier répétiteur R L qui, lorsqu'il est abaissé, place la machine dans les conditions requises pour répéter le nombre frappé précédemment sur le clavier.

A l'avant de chacune des divisions du clavier se trouve une touche de correction C R qui, lorsqu'elle est abaissée, ramène toutes les touches à leur position haute et efface la division correspondante, en la laissant prête à recevoir une nouvelle impression. Donc, si par erreur un nombre erroné a été frappé sur le clavier, celles des touches qui ont été frappées à faux peuvent être effacées en abaissant la touche de correction des divisions correspondantes du clavier, après quoi on peut opérer la manipulation correcte des touches et placer la machine dans les conditions requises pour tourner en imprimant le nombre corrigé et en l'ajoutant ou le retranchant sur les roues compteuses. Pour couper court à des corrections importantes, on peut abaisser et relever le levier totalisateur T L, de manière à effacer la totalité du clavier, mais sans agir sur les roues compteuses ni imprimer le nombre.

Dans la présente machine, il est possible de s'assurer que toute la machine est effacée, en regardant simplement les roues compteuses par les fenêtres sans donner une frappe pour imprimer le total, comme il est nécessaire dans d'autres machines.

Comme le signe d'identification d'un total est différent de celui d'un sous-total, la feuille imprimée montrera toujours si un total précédent laissé sur la machine a été additionné dans le nouveau compte ou a simplement été imprimé sur la feuille en même temps qu'il a été effacé des roues compteuses. Ce fait permet à l'opérateur de le soustraire ultérieurement, dans le cas où il aurait été additionné par erreur au début.

La machine comporte également un dispositif qui indique si elle a été manœuvrée au-delà de son point limite. Il existe, à cet effet, un signe d'impression qui entre en jeu pour avertir l'opérateur qu'il risque d'obtenir un total erroné. En cas de dépassement, le signe d'identification ou d'avertissement entre en action immédiatement et tant que l'opérateur sera au-delà de la limite négative de la machine dans sa position de soustraction, le signe d'identification sera répété à la suite de chaque nombre, même si on n'a pas dépassé de plus d'une centaine. Le signe d'avertissement n'apparaît pas après des nombres qui sont additionnés en vue de compenser un dépassement, comme dans le cas d'un compte de banque où il existe des dépôts qui tendent à réduire le dépassement du compte. Après qu'un dépassement aura été complètement effacé, le signe d'avertissement disparaîtra de la feuille et la machine ayant été rappelée de sa situation anormale au-delà du point limite, continuera à additionner et à soustraire et donnera les totaux de façon normale.

La machine est réglée de telle sorte que quand elle fonctionne au-delà du point limite, soit positivement, soit négativement (soit que la machine soit réellement à bout, soit qu'il y eut un dépassement), le mécanisme totalisateur sera calé de manière qu'il sera impossible à l'opérateur de prendre un total jusqu'à ce que la machine ait été rappelée de sa situation anormale ou ramenée en arrière en-deça de son point limite.

La machine comporte également un mécanisme duplicateur au moyen duquel un nombre quelconque, au moment où il est entré sur la machine, peut être mis en réserve sur une série auxiliaire de roues compteuses sans gêner aucune des opérations que la machine peut avoir à effectuer, et être conservé indéfiniment jusqu'à ce que l'opérateur, à un moment ultérieur, désire pour un motif quelconque reporter ce nombre sur la machine. Le nombre ainsi mis en réserve peut être soit reporté sur la machine et effacé des roues compteuses du duplicateur, soit reporté sur la machine et maintenu sur les roues du duplicateur, au gré de l'opérateur. La commande de ce mécanisme est représentée à la figure 1, où DL désigne le levier duplicateur. Pour mettre en réserve un nombre, par exemple le numéro d'un bulletin de chargement ou d'un wagon, indépendamment des organes compteurs ou imprimeurs de la machine, et en vue de son report ultérieur sur cette dernière, l'opérateur pousse en avant le levier DL, après quoi le nombre est enroulé sur les roues compteuses D^1 à D^9 du duplicateur, quand on fait tourner la machine, quelle que soit l'opération que la machine effectue avec ce nombre. Après que l'on a fait tourner la machine, le levier DL est ramené à sa position centrale, que montre la figure 1. Pour reporter ce nombre, entré ainsi, sur les roues porteuses D^1 à D^9, l'opérateur pousse en arrière le levier duplicateur, après quoi ledit nombre est reporté sur la machine, exactement comme s'il avait été frappé sur le clavier, pour être compris dans toute opération que peut effectuer la machine, et en même temps il est effacé des pignons duplicateurs D^1 à D^9. Pour maintenir le nombre sur les roues compteuses D^1 à D^9 du duplicateur après qu'il a été reporté sur la machine, l'opérateur manœuvre les leviers DL et DRL, après quoi le nombre sera reporté sur la machine, mais en même temps il demeurera inscrit sur les roues compteuses D^1 à D^9 du duplicateur.

Clavier (figures 1 à 7). — La figure 1 montre les divisions séparées S^1, S^2, S^3, etc., à S^9 du clavier.

La figure 2 représente l'une des divisions dans sa position active.

La figure 3 est une vue schématique qui indique le mode de fonctionnement du clavier.

La caisse de la machine comprend la plaque de base 1 et un couvercle approprié, comportant des côtés 2 et 3 et une partie supérieure 4, cette dernière étant munie d'une ouverture vitrée 5 qui découvre les petites fenêtres par lesquelles les roues compteuses N^1, N^2, N^3 à N^9 sont visibles.

Chaque division du clavier comprend la plaque de paroi 6 qui porte les tiges des touches, les tringles d'arrêt et d'autres organes actifs de la division. La plaque porte à l'avant un rebord 7 de même largeur que les pièces actives de la division, et qui sert à fermer l'avant du clavier quand celui-ci est entièrement monté. Au bord supérieur de la plaque 6 se trouve une plaque transversale 8 munie de mortaises par où passent les tiges des touches. Les touches K^1, K^2, K^3 à K^9 sont montées respectivement sur des tiges correspondantes 9 qui comportent chacune une saillie 10, destinée à limiter son mouvement en avant, ainsi qu'un ergot 11 en saillie vers l'avant qui sert à la fois de came, en vue de commander une tringle d'arrêt, et de butée pour empêcher le mouvement ascendant de la tige jusqu'à ce que celle-ci ait été libérée après avoir rempli son office consistant à conserver la frappe jusqu'à ce que la machine soit manœuvrée.

Coopérant avec l'ergot 11, l'étrier 12 (figures 3 et 4) pivote en 13 et est pressé contre la tige de touche par le bras 14, en forme de selle, qui pivote également en 13 et porte une saillie 15 tirée constamment de haut en bas par le ressort à spirale 16. L'extrémité supérieure de la selle 14 est reliée à pivot en 17 à la tringle d'arrêt 18, dont l'autre extrémité est courbée à angle droit en 18′ et est guidée de manière à servir d'arrêt à des mécanismes coopérant avec les roues compteuses et le mécanisme imprimeur. L'extrémité inférieure de chaque tige de touche se prolonge presque jusqu'au bord in-

férieur de la plaque 6. Le bout inférieur extrême de chaque tige de touche est recourbé transversalement et fixé à l'extrémité inférieure du ressort 16, en sorte que ce ressort non seulement remplit la fonction de tirer de haut en bas le bras de selle 15 pour chasser en avant dans sa position d'arrêt la tringle d'arrêt 18 chaque fois qu'une tige de touche est abaissée suffisamment pour permettre à l'étrier 12 de s'enclencher au-dessus de l'ergot 11, mais encore chasse la tige de touche de bas en haut après que la machine a agi et quand ladite tige doit être renvoyée à sa position normale.

Chaque étrier 12 comporte en prolongement inférieur un bras 19 qui dégage l'étrier de l'ergot 11 quand les touches doivent être ramenées à leur position normale et qui ramène également à sa position normale l'arrêt correspondant. Pour la commande du bras 19, la plaque 20 est montée à coulisse contre le côté 6 de la division, lequel lui sert de support, et elle comporte des saillies transversales 21 disposées de manière à frapper les bras 19 quand la plaque 20 est déplacée longitudinalement. Pour déplacer cette plaque de dégagement, un épaulement 22 se trouve placé au-dessus d'un arbre oscillant 23 qui porte une lame de poussée 24 fixée rigidement et destinée, au cours de sa rotation, à venir en contact avec l'épaulement 22 à chaque manœuvre de la machine, poussant ledit épaulement vers la droite (figure 3) et communiquant à la plaque de dégagement 20 un déplacement suffisant pour amener les saillies 21 en prise avec les bras 19 de manière à écarter les étriers des ergots 11 et à permettre aux touches de revenir à leur position normale. Le ressort à boudin 25 fixé à l'extrémité arrière de la plaque de dégagement 20 ramène cette dernière au point normal après que l'arbre oscillant 23 est revenu en arrière.

Quand il s'agit de prendre un total, ce déplacement longitudinal de la plaque de dégagement est produit par l'arbre 26 qui porte la plaque de butée 27 destinée à venir en prise avec l'épaulement 28 de la plaque de dégagement. On est assuré, par là, que toutes les tringles d'arrêt seront «hors du passage» ou dans leur position de retrait pendant une totalisation et qu'aucune erreur ne pourra se glisser dans le total du fait de la manipulation du clavier.

Dans le cas où des corrections doivent être faites à la frappe des touches d'une division quelconque, afin d'effacer un nombre frappé à faux, avant de manœuvrer la machine il faudra avoir recours à la touche de correction CK, cette dernière étant mobile de haut en bas en opposition à la tension du ressort à boudin 29 et étant reliée à pivot par son extrémité inférieure, en 30, au levier coudé 31 oscillant autour du pivot 32 et dont le bras supérieur pivote en 33 sur la bielle coulissante 34 dont la partie arrière comporte une encoche destinée à venir en prise avec l'ergot 35 en saillie latérale sur la plaque de dégagement 20. Il en résulte que le mouvement descendant de la touche de correction pousse en arrière la bielle 34 et fait coulisser longitudinalement la plaque de dégagement 20 d'une longueur suffisante pour dégager toutes les touches de la division, leur permettant ainsi de revenir à leur position normale. La bielle coulissante 34 est montée de manière à pouvoir osciller de bas en haut en se dégageant de la butée 35, en sorte que lorsque la machine commencera à tourner, l'opérateur ne pourra plus changer les frappes du clavier en manipulant la touche de correction CK.

En d'autres termes, les touches de correction cessent d'être en liaison active avec la plaque coulissante 20 à chaque manœuvre de la machine, immédiatement avant la mise en marche de cette dernière, et la liaison n'est rétablie que lorsque la machine est revenue à sa position normale. Pour obtenir ce résultat, l'arrière de la bielle 34 est recourbé vers le bas et muni d'une semelle 36 qui s'appuie sur la barre à bascule 37 qui se déplace de bas en haut au début de chaque course de la machine, de manière à rabattre de bas en haut la bielle 34, comme il est indiqué en pointillé à la figure 3, et la bielle demeure levée jusqu'après l'achèvement de la course.

Les détails du bord inférieur de la plaque 6 sont représentés aux figures 3, 5 et 7, et ils comprennent trois barres 38, 39 et 40, qui portent à coulisse la plaque de dégagement 20, ces barres portant également des plateaux espacés 41, entre lesquels sont guidées les extrémités inférieures des tiges de touches et au-dessous desquels les extrémités en forme

de crochet des tiges dépassent de manière à être en prise avec leurs ressorts respectifs 16. L'un de ces plateaux sert de butée pour limiter le mouvement ascendant de la tige de touche. Les plateaux 41 sont maintenus en place par la tige de laiton 42 qui se prolonge au travers des trois barres 38, 39 et 40. Cette tige de laiton remplit l'office d'un verrou dont le retrait dégage le plateau extérieur 41 et permet de retirer tous les étriers 12 et toutes les selles 14 aussitôt que leurs ressorts 16 sont décrochés, ce qui permet alors d'enlever toutes les tiges de touches à travers la plaque supérieure 8 et de pousser en avant hors de leurs mortaises toutes les tringles d'arrêt 18 et de les retirer de leur division. Les opérateurs peuvent remonter ces pièces sans outils mécaniques, en se servant uniquement des doigts pour remettre les pièces en place, puis accrocher les ressorts de retenue 16, et en faisant glisser jusqu'à la position requise le verrou de retenue ou fil de laiton 42.

Chaque fois que l'on abaisse l'une des touches d'une division, l'épaulement 43 voisin de l'extrémité supérieure de la tige de touche, vient en prise, de manière à le faire tourner, avec un galet monté sur un tourillon 44 en saillie sur la plaque 45 disposée près de la partie supérieure de la division et oscillant sur trois biellettes pivotantes 46. La principale fonction de la plaque coulissante 45 consiste à se déplacer vers l'avant jusque sur l'arrêt du zéro, aussitôt qu'un nombre a été entré sur le clavier par l'abaissement de l'une des touches. Ce résultat est obtenu grâce à la bielle pivotante 47 (figures 3 et 6) dont l'extrémité arrière est munie d'un crochet venant en prise avec le galet 48 porté par la plaque oscillante 49, pivotant en 50 et portant à son extrémité inférieure la tringle d'arrêt 51 montée à pivot (et qui constitue la tringle d'arrêt du zéro), dont l'extrémité recourbée coulisse dans la mortaise du zéro d'une plaque 52 formant un segment de guidage. Le ressort à boudin 53 tire normalement la plaque 45 vers l'arrière et tire en même temps vers l'avant l'angle supérieur de la plaque 49, remplissant ainsi la double fonction de ramener la plaque 45 à sa position normale et de remettre en place la tringle d'arrêt 51 après chaque opération.

Pour ramener aussitôt que possible à sa position active la tringle d'arrêt du zéro, on a établi une plaque 54 coulissant verticalement, dont l'extrémité supérieure est reliée à rainure en 55 avec la bielle 47 et dont l'extrémité inférieure comporte une rainure destinée à recevoir la tige de contrôle à mouvement vertical 56 (figure 3) qui se déplace mécaniquement en montant et en descendant à chaque opération de la machine et qui descend sur la plaque 54 immédiatement après que le bras oscillant ou bec d'arrêt S N a dépassé la tringle d'arrêt 51, dégageant ainsi le levier coudé 49 et permettant à son extrémité inférieure de remettre en place l'arrêt du zéro.

Il n'est pas possible que l'arrêt du zéro retienne le bec pendant une partie de l'oscillation d'arrière en avant et l'abandonne ensuite pour l'équilibrage de l'oscillation, car dès que l'oscillation a commencé la tringle du zéro cesse effectivement d'être reliée au clavier et l'abaissement des touches n'en opèrera pas le rappel. Aussitôt que l'oscillation vers l'avant est complétée, l'arrêt du zéro entre en action et il peut être rappelé par l'abaissement d'une touche, même dans le cas où le bec d'arrêt en est à son oscillation de retour.

Ainsi, à chaque opération de la machine et en vertu d'un réglage approprié par rapport à cette dernière, la tige de contrôle 56 se déplace de haut en bas et elle demeure dans sa position basse jusqu'à ce que le cycle soit achevé ou jusqu'à ce que la machine soit de nouveau presque au repos, permettant ainsi à la tringle d'arrêt du zéro de venir à la position d'arrêt à l'instant où le bec d'arrêt l'a dépassée, mais offrant à l'opérateur la possibilité de presser de haut en bas une nouvelle touche, frappée à l'instant où le bec d'arrêt commence à osciller en arrière ou, en d'autres termes, à l'achèvement d'une demi-course. Les touches peuvent alors être abaissées même dans le cas où leurs tringles d'arrêt se trouveraient sur le passage du bec oscillant de bas en haut, car dans ce cas le bec les renverrait simplement en arrière et passerait, les tringles revenant alors à leur position d'arrêt. L'opérateur peut donc agir très franchement en manœuvrant les touches, car il dispose de cinquante pour cent de la durée totale d'un cycle complet pour frapper les touches en vue de l'opération suivante, en regard de dix pour cent environ comme dans les machines d'usage courant. Le mouvement

de retour ou de bas en haut de la plaque 54 renverra la butée du zéro si dans l'intervalle une touche quelconque a été abaissée, en sorte que la machine pourra effectuer une autre oscillation descendante dès son retour ou dès l'achèvement de l'oscillation précédente. Si l'opérateur désire répéter un nombre, il lui suffit simplement de maintenir abaissées les touches correspondantes et de permettre au moteur de faire tourner la machine autant de fois que le nombre doit être répété. Il n'est jamais repoussé du clavier, car il n'y a pas de renvoi brusque des touches.

Cette partie de la machine comporte également une autre plaque de contrôle 57 coulissant verticalement, superposée à la plaque 54 et qui, dans la figure 3, la recouvre largement, laquelle entre en action, quand il s'agit de prendre un total, en coulissant de bas en haut de manière à chasser son extrémité supérieur 57′ contre un galet 48 en repoussant ce galet vers l'arrière et en rappelant la butée du zéro. Ce mouvement vertical est commandé par la plaque 58, en forme de cornière, à l'extrémité inférieure de la plaque 57, et les mouvements ascendant et descendant de la plaque 58 sont réglés par le mécanisme totalisateur. Simultanément, avec le mouvement ascendant de la plaque 57 en vue de rappeler la butée du zéro pour prendre un total, l'arbre oscillant 26 oscille de manière à amener sa lame 27 en prise avec l'épaulement 28, en faisant coulisser du même coup, la plaque de dégagement 20 et ramenant en arrière toutes les selles et tous les étriers et rappelant toutes les tringles d'arrêt et laissant le bec d'arrêt libre de tout risque d'obstruction du fait de la manipulation du clavier. Le bec est libre d'osciller suivant l'arc entier de sa course, ce qui est nécessaire pour que son oscillation corresponde à la frappe des roues de l'accumulateur.

Dans certaines machines on juge nécessaire de caler le clavier quand il y a lieu de prendre un total. Dans la présente machine, au contraire, les touches ne sont pas calées pendant une totalisation et elles peuvent être manœuvrées à volonté en raison de la disjonction effective entre les tiges des touches et leurs tringles d'arrêt respectives. Cette caractéristique a une grande importance.

Toutes les divisions du clavier peuvent facilement être retirées de la machine, chacune à l'état d'unité distincte et en un tout indépendant des autres, les autres divisions pouvant continuer à fonctionner, même dans le cas où plusieurs de ces divisions auraient été démontées. L'une quelconque de ces divisions peut être enlevée en retirant la tige 59, qui traverse toutes les divisions ainsi que le bâti de la machine, et en poussant la division intéressée en avant et de bas en haut, hors d'encliquetage avec les barres tranversales 60, 61 et 62 du bâti qui normalement lui servent de supports. Pour être assuré que la machine fonctionne normalement quand une division a été enlevée, on a établi une barre 62′ qui fait fait partie du mécanisme d'enclenchement général.

L'accumulateur (figures 2, 8, 15, 16 et 17). — Le mécanisme accumulateur, dans son ensemble, comprend des pignons portant des roues numérotées, une crémaillère oscillante pour chacune de ces roues, un dispositif destiné à mettre chaque pignon en prise avec sa crémaillère dès que cette dernière se met en mouvement dans un sens ou dans l'autre quand la roue doit subir une rotation (par exemple quand un nombre doit être additionné ou soustrait) et à le mettre hors de prise à l'achèvement de la course. Y est compris également un mécanisme destiné à permettre à la crémaillère de coulisser par rapport au bec d'arrêt sur une distance égale à une largeur de dent, dans un sens ou dans l'autre, afin que, après une révolution complète d'une roue chiffrée, le nombre qu'elle représente puisse être reporté sur la roue suivante en faisant tourner cette roue d'une largeur de dent. Ce mécanisme de report comprend un système à cliquet et déclic au moyen duquel le mouvement coulissant peut effectivement opérer un report d'une roue sur la suivante, dans un sens ou dans l'autre.

Il existe également un mécanisme destiné à faire osciller les segments dentés, à faire osciller les becs d'arrêt, à faire coulisser les pignons en prise ou hors de prise avec leurs crémaillères, et en général à régler l'action combinée des divers organes.

Chaque pignon accumulateur 63 (figure 17) porte une roue compteuse 64 et est monté à pivot à l'extrémité d'un bras de support 65 fixé rigidement à un arbre oscillant 66.

Lorsque le pignon se trouve dans sa position la plus élevée, il est calé contre tout mouvement accidentel par la dent de retenue 67 disposée sur la barre 67′ qui entretoise les côtés du bâti de la machine; mais quand le pignon occupe sa position inférieure il engrène avec le segment denté 68 monté de manière à être entraîné à friction par l'arbre oscillant principal 69. L'arbre 69 commande également à friction, et dans le même organe à friction que le segment 68, le bras 70 portant le bec d'arrêt SN; ce bras peut osciller de haut en bas entre les plaques de guidage 52 des tringles d'arrêt jusqu'à ce qu'il vienne à frapper l'une desdites tringles d'arrêt 18 et son mouvement oscillant commandera la rotation du segment denté 68, sauf que ce dernier peut se déplacer en arrière ou en avant d'une largeur de dent, par rapport au bec d'arrêt, et peut ainsi être amené à faire un report d'une roue d'accumulateur sur l'autre. Les bras 70 du bec d'arrêt portent des dents de crémaillère.

Le mécanisme au moyen duquel s'effectue le glissement entre le segment denté et son bec d'arrêt, comprend le cliquet à pivot 71, porté par le bras 70 du bec d'arrêt et entaillé de manière à venir en prise avec l'ergot 72 porté par le segment denté 68 et en saillie latérale vers l'extérieur de ce dernier, lequel segment constitue la crémaillère qui engrène avec le pignon accumulateur 63. Le cliquet 71 est commandé par la tringle de poussée 73 pivotant sur le levier oscillant 74 qui à son tour pivote en 75 et dont l'angle supérieur 76 est placé de manière à frapper l'ergot de commande 77 en saillie latérale sur le déclic 78 qui pivote en 79 et qui porte à son extrémité extérieure le galet 80, qui au moment requis, peut être poussé de haut en bas en vue d'élever la butée 77 à partir de l'avant de l'angle 76, ce qui, grâce à l'action du ressort à boudin 81, permet au levier 74 de tirer sur la tringle 73 et d'écarter le cliquet 71 de l'ergot 72, permettant ainsi à la crémaillère de se déplacer par rapport au bec d'arrêt (ou *vice versa*) d'une distance égale au pas. Le levier de déclic 78 est abaissé au moyen de la came 80′ montée rigidement de manière à tourner avec le pignon suivant 63 à la droite de la figure 1 et avec la roue compteuse 64. La came présente un contour circulaire, avec un angle saillant disposé de manière à frapper le galet 80 du déclic de la division suivante pendant que le pignon 63 et sa roue compteuse 64 tournent de la position «9» à la position zéro, ou inversement. C'est là le point où la roue a rempli sa fonction d'accumulateur et doit faire le report sur la roue suivante.

Quand il s'agit de faire une soustraction tous les pignons accumulateurs 63 viennent en prise avec les crémaillères 68 au début de de la course descendante des crémaillères et des becs d'arrêts; quand il y a lieu de faire une addition, ils s'engrènent au début de la course ascendante ou de retour. En supposant maintenant que l'on effectue une soustraction, chaque bec d'arrêt s'abaisse jusqu'à ce qu'il frappe une tringle d'arrêt. Si un report doit être exécuté, c'est-à-dire si l'une quelconque des roues compteuses 64 tourne de la position «9» à la position «0», sa came 80′ agira de manière à abaisser le cliquet 71 de la division suivante, ce qui permettra à la crémaillère 68 correspondante de se déplacer en dépassant le bec d'arrêt 70 jusqu'à ce que l'ergot 72 vienne heurter l'extrémité inférieure de l'entaille de la pièce 70, soit d'une distance correspondant à une dent. Ce mouvement relatif de la crémaillère 68 par rapport au bec d'arrêt 70 est rendu possible par la liaison à joint coulissant entre ces deux organes, lesquels sont tous deux chassés de haut en bas par l'arbre 69 sur lequel chacun d'eux est monté à friction. Il en résulte que l'accumulateur ou pignon qui vient immédiatement à la suite de celui qui tourne du «9» au «0», retourne en arrière d'une dent. Quand on effectue une addition, la même opération exactement s'exécute, si ce n'est que cette dernière se produit pendant le mouvement de retour du bec d'arrêt 70. Quand le bec d'arrêt, à la fin de sa course de retour, se trouve arrêté par la barre 60, la crémaillère 68 (à condition que le cliquet 71 ait été abaissé) se met en mouvement, sous l'impulsion à friction de l'arbre 69 jusqu'à ce que l'ergot supérieur 72 vienne en contact avec l'extrémité supérieure de sa mortaise, faisant ainsi avancer le pignon accumulateur de la longueur d'une dent par rapport à son bec d'arrêt.

Pour remettre en place le déclic 78 et le levier 74 qu'il commande, on a établi l'arbre

82 qui porte un système de lanterne comprenant les rouleaux 83 et 84, ce dernier ayant pour fonction de faire osciller le levier 74 en opposition à l'action du ressort 81 qui le maintient, lorsque les organes doivent être remis en place. Le levier 74 comporte une saillie à came 85 qui oscille d'arrière en avant lorsque le levier s'abaisse et se trouve en conséquence sur le passage du rouleau 84, lequel, en frappant la saillie renverra le levier à sa position d'encliquetage, et, ce faisant, chassera le cliquet 71 vers l'avant afin qu'il vienne en prise avec l'ergot 72 et enclenche le bec d'arrêt SN par rapport au segment denté, à la condition que le cliquet et l'ergot se trouvent dans la position relative convenable,

Par suite de la liaison à joint coulissant entre la crémaillère 68 et le bec d'arrêt 70, chaque fois que le cliquet 72 a été dégagé, à l'achèvement de la course ascendante, le bec d'arrêt 70 se trouvera toujours maintenu contre la barre 60 et la crémaillère 68 se trouvera maintenue par le contact de l'ergot 72 avec l'extrémité supérieure de la mortaise de la pièce 70. Placé immédiatement à l'avant du champ d'action du rouleau 84, l'autre rouleau 83 oscille en rond jusqu'à venir en contact avec l'épaulement saillant 85′ du segment denté 68 et pousse ledit segment vers l'avant, par rapport au bec d'arrêt 70 sur une distance égale à une dent de telle sorte que l'ergot 72 se trouvera au milieu de sa mortaise et dans une position telle qu'il sera saisi par le cliquet 71 quand celui-ci sera soulevé. Cette remise en place du bec d'arrêt et de la crémaillère se produit à l'achèvement d'une course complète de la machine.

Les déclics 78 et les leviers qui coopèrent avec eux, de même que leurs ressorts respectifs 78′ et 81, sont montés sur la plaque 87 en forme d'L, et reliés à celle-ci par des traverses, conformément à ce qui pourrait être appelé une « disposition de pendule », et chaque plaque en L, avec sa charge de ressorts et d'organes oscillants, constitue en soi une unité qui peut être montée simplement à la main par le monteur, puis glissée en place par l'arrière de la machine, sa partie principale, à l'avant, entaillée et embrassante, venant sur la barre transversale 60 rainée en vue de la recevoir. Les plaques en L 87 sont situées de manière à être traversées et fixées par la même tige 59 qui maintient en place le clavier. L'extrémité arrière ou supérieure des plaques 87 est conformée de façon à embrasser la traverse arrière supérieure 88 du bâti.

La lanterne comprend des plaques d'extrémité 82′ portant les rouleaux 83 et 84, la lanterne entière pouvant tourner sur l'arbre 82. La plaque 82′ comporte un angle arrondi prolongé 82^a auquel est reliée à pivot la bielle 82^b dont l'autre extrémité porte un tourillon monté dans une mortaise cintrée 82^c percée dans le prolongement en forme d'aile 82^d de la plaque 154′ montée sur l'arbre 155. Normalement, la bielle 82^b est maintenue dans sa position antérieure par le ressort 82^e. L'ergot 82^f en saillie en avant de la paroi latérale du bâti, sert de butée à la plaque 82′ et il vient également en prise avec l'extrémité en forme de crochet de la bielle 82^b quand cette dernière se trouve dans sa position antérieure. La machine étant au repos et la plaque 154′ dans sa position postérieure, la lanterne occupe la position qu'indique la figure 10, suivant laquelle les rouleaux 83 et 84 sont respectivement en contact avec les ergots 85′ et 85 (figure 17). Mais, aussitôt que commence la course en avant de la plaque 154′, la bielle 82^b sous l'action du ressort 82^e, suit ladite plaque jusqu'à ce que son extrémité en forme de crochet vienne en prise avec l'ergot 82^f après quoi la bielle 82^b s'arrête, tandis que la plaque 154′ poursuit sa course. Dans cette position, les rouleaux 83 et 84 sont dégagés des ergots 85 et 85′ et le prolongement arrière 82^a de la plaque 82′ a été rabattu vers l'intérieur. Les organes demeurent dans cette position jusqu'à ce que la plaque 154′ soit revenue à une position suivant laquelle l'extrémité avant de la mortaise 82^c vient heurter le tourillon à l'extrémité de la bielle 82^b, après quoi l'extrémité en forme de crochet de ladite bielle se trouve dégagée de l'ergot 82^f et les diverses pièces reviennent à la position de la figure 10, amenant en alignement les crémaillères 68 et 70 et mettant en prise le cliquet 71 avec son ergot.

Commande à joint coulissant des porte-caractères et des becs d'arrêt. — Le joint à coulisse entre l'arbre oscillant principal 69 et les bras 70 des becs d'arrêt et les bras 68 des segments dentés, comprend une série de bo-

bines 89 et de bagues 90 qui ménagent des passages de touche pour recevoir la languette 91 de l'arbre 69; ces bobines et ces bagues peuvent coulisser sur l'arbre, mais elles tournent constamment avec lui. Sur l'une des faces de chaque bague se trouve un levier porte-caractère 92 dirigé vers l'arrière de la machine et portant la tête de caractère amovible correspondant à une des divisions de touches; l'autre extrémité dudit levier constitue le bras 70 qui porte à son extrémité antérieure le bec d'arrêt qui règle l'oscillation du segment denté. Sur l'autre face de ladite bague se trouve le bras 68 du segment denté.

La liaison entre chaque bague et les bras 92 et 68 qui coopèrent avec elle est réalisée au moyen de brides portées l'une par la bague et l'autre par la bobine adjacente, en sorte que ces bras n'ont pas besoin de venir en contact direct avec l'arbre oscillant principal 69. Pour assurer une portée parfaite et une surface parfaite, chacun des bras oscillants 92 et 68 est garni sur ses deux faces de disques de maillechort 92' et 68' coulés sur la pièce et dont la surface a été dressée avec soin avant le montage de la machine. De petits trous peuvent être percés à travers les bras afin que le disque coulé sur une face soit relié intimement au disque coulé sur l'autre face. Pour assurer une portée et un graissage uniforme, l'arbre oscillant 69 est creux et il comporte une alimentation d'huile à l'une de ses extrémités ainsi que des rainures radiales aboutissant à une poche d'huile à chaque joint à coulisse. Pour assurer la régularité du mouvement à coulisse et la tension uniforme des diverses pièces du joint, on a établi à une extrémité de l'arbre oscillant un ressort à spirale 93 qui est enroulé autour de l'arbre et qui s'appuie directement sur le disque extrême, la pression étant transmise de part en part d'une bague ou bobine à la suivante, la série se terminant par le disque 14 qui est goupillé à demeure sur l'arbre. Le ressort 93 est renfermé dans une douille 93' (figure 19), et au montage on le règle à la tension requise qu'il n'y a jamais lieu de modifier en service normal.

Mécanisme de réglage de l'addition et de la soustraction. — Le mécanisme de réglage (figures 8, 11 et 12) détermine si la machine doit additionner ou soustraire, lorsqu'un nombre déterminé a été frappé sur le clavier. Ce mécanisme comprend le levier à main L monté à pivot sur le bâti de la machine et qui, dans sa position arrière (figure 11) se trouve dans la position d'addition, mais qui peut être rabattu vers l'avant à la position de soustraction. Quand il est poussé en arrière (figure 11), le galet 131 monté sur le levier L passe, en descendant, au-delà de la mâchoire inférieure de l'extrémité évidée du levier oscillant 132 porté par l'arbre 189 et fait osciller de bas en haut l'extrémité arrière dudit levier, poussant en même temps de bas en haut la bielle 133 dont l'extrémité supérieure porte le galet 134 mobile dans la mortaise de la plaque 135 sur laquelle est rivée la plaque 135'. La disposition permet au galet 134, qui porte une joue sur la face interne de la pièce mortaisée 135, de dépasser le pivot de cette dernière. La pièce 135 comporte à son extrémité arrière un bras 137 muni d'une mortaise came destinée à recevoir le galet 138 monté sur l'extrémité inférieure du bras oscillant 139, lequel est rigide sur l'arbre oscillant 66 et sert à régler les oscillations vers l'intérieur et vers l'extérieur des bras de support 65 qui portent les pignons accumulateurs 63, les roues compteuses 64, les cames d'arrêt 80' et les butées totalisatrices 80ª.

Reliée à pivot avec la tige du galet 134 et avec l'extrémité supérieure de la bielle 133 une autre bielle 140 est montée à pivot sur l'extrémité supérieure de la plaque 141 qui pivote sur le bout d'arbre 142 et elle porte à son extrémité inférieure le galet 143 et à son angle postérieur le talon de retenue 144. La plaque auxiliaire 145 est montée à pivot sur le bout d'arbre 142 et elle peut osciller par rapport à la plaque 141, servant à soumettre cette dernière à une tension à chaque mouvement de la machine en avant ou en arrière, en sorte que les roues compteuses 63 glisseront en prise ou hors de prise à des moments requis. A cet effet, on a intercalé entre la plaque 145 et la plaque 141 un ressort 146 qui est enroulé autour de l'arbre 142 et dont les deux extrémités se prolongent vers le haut en divergeant, lesdites extrémités étant fixées respectivement dans les plaques de guidage 147 et 148 qui toutes deux oscillent librement autour de l'arbre 142 et servent surtout

à maintenir les extrémités du ressort pour que celles-ci remplissent leur office. Les divers éléments occupant les positions indiquées aux figures 11 et 12, la plaque de guidage 147 portée par le ressort, sera en contact avec la tige 150 à l'extrémité supérieure du levier 141 et l'autre plaque 148, portant le ressort sera en contact avec la butée 151 en saillie au sommet de la plaque oscillante 145, mettant ainsi sous tension les deux pièces et tendant à ramener la tige 150 vers la butée 151.

En se reportant à la figure 8, le dispositif qui fait osciller la plaque 145 consiste en une paire de tiges 152 et 153 montées sur la face extérieure de la plaque de réglage principale 154 commandée par l'arbre 155 et qui tourne sur ce dernier en avant et en arrière, à chaque course de la machine. Le bord supérieur de la plaque 154 comporte une joue 156 en saillie latérale, qui sert de came de retenue pour s'opposer à tout mouvement du galet 143 jusqu'à ce que la machine ait atteint dans sa course exactement le point requis, et qui, ensuite, libère le galet pour permettre à la plaque 141 de se rabattre par-dessus en réaction de la tension qui, dans l'intervalle, a été exercée sur elle par le ressort 146, attendu que ce dernier, dans le même temps, a subi la charge résultant du mouvement oscillant qui a été communiqué à la plaque 145 par l'une ou l'autre des tiges 152 et 153 venue en prise avec elle. En d'autres termes, les tiges montées sur la plaque 154 font osciller le levier 145 en arrière ou en avant à chaque opération de la machine, faisant passer en même temps la tension du ressort d'un côté à l'autre, par rapport à la plaque 141, et c'est au galet 143 qu'est dévolue la fonction d'empêcher les pièces de glisser au travers jusqu'à ce que la machine se trouve dans la position précise, laquelle est définie par la libération du galet 143 grâce à la joue de réglage 156 en saillie latérale sur le bord supérieur de la plaque 154, le galet 143 se trouvant confiné au-dessous de la joue 156 pendant la première demi-rotation de la machine et au-dessus de la même joue pendant la deuxième demi-rotation. L'objet de ce mécanisme consiste à mettre les pignons accumulateurs 63 en prise et hors de prise avec les crémaillères 68, à l'instant requis.

La figure 11 montre la position qu'occupent les divers organes avant que la roue 154 ait commencé sa course en avant et pendant que le levier L est dans sa position arrière ou d'addition. Le galet 134 se trouve alors au sommet de la mortaise de la plaque 135. La course en avant de la roue 154 commencera par enclencher le galet 143 au moyen de la joue 156, puis elle fera osciller l'extrémité inférieure du levier 145 grâce à la tige 153 qui vient en contact avec ce dernier. La butée supérieure 151, ménagée sur le levier 145, déplacera vers la droite le bras oscillant 148 et le ressort de tension 146, sans toutefois déplacer la tige 150 puisque la plaque 141 est calée. Mais aussitôt que la joue 156 aura dépassé le galet 143, la plaque 141 sera libre d'osciller, et par suite de la tension du ressort 146 appliquée par la pièce 147, sera rabattue vers la droite. Il en résultera une poussée d'avant en arrière communiquée à la bielle 140 et qui fera basculer la plaque 135 dans le sens des aiguilles d'une montre, ce qui abaissera le bras 137 et, grâce à la mortaise-came ménagée dans ce dernier, fera basculer le levier 139 et engrener le pignon-accumulateur 63 avec la crémaillère 68. Le mouvement de retour de la roue 154 calera d'abord le galet 143 dans sa nouvelle position, maintenant ainsi le pignon 63 en prise avec la crémaillère 68, après quoi la tige 152 viendra buter contre le levier 145 en tendant le ressort 146 en sens inverse, en sorte que, à la fin de la course de retour, quand le galet 143 sera libéré grâce à la joue 156, le ressort 146 agissant maintenant par l'intermédiaire du bras 148, déterminera une impulsion en avant communiquée à la bielle 140, faisant ainsi basculer la plaque 135 en sens inverse des aiguilles d'une montre, ce qui, grâce à la mortaise cintrée de ladite plaque, fera osciller le bras 139 vers la gauche et mettra le pignon accumulateur 63 hors de prise avec la crémaillère 68. Ainsi donc, pendant que la machine effectue les additions, les pignons accumulateurs sont maintenus dégrenés pendant la course en avant et ils sont engrenés pendant la course en arrière, et à la fin de cette course en arrière ils sont dégrenés automatiquement.

L'opération de la soustraction est analogue. Pour celle-ci, le levier L se trouve dans

sa position antérieure, le levier 132 est poussé vers le bas à son extrémité arrière, ce qui fait que le galet 134 se trouve à l'extrémité inférieure de la mortaise de la plaque 135. C'est exactement la même opération des autres pièces qui maintiendra le pignon accumulateur 63 engrené pendant la course avant, qui le mettra hors de prise au début de la course arrière, et qui le ramènera en prise à la fin de cette dernière course. Il faut qu'il en soit ainsi, parce que le fonctionnement de toutes les autres pièces étant exactement le même dans les deux cas, dans l'opération de la soustraction, la bielle 140 (étant abaissée) communique une impulsion à l'extrémité opposée de la plaque pivotante 135, faisant chaque fois basculer cette plaque dans le sens exactement opposé à celui dans lequel elle la ferait basculer dans la même phase de l'opération s'il s'agissait d'additionner. En renvoyant le levier L (figure 11) de la position arrière (d'addition) à la position avant (de soustraction) on se souviendra que quand le galet 134 se déplace du sommet vers la base de la mortaise de la plaque 135, cette dernière tournera sur son pivot central et que son extrémité supérieure viendra occuper sa position extrême de droite au lieu de sa position extrême de gauche indiquée à la figure 11, renversant ainsi la position des roues compteuses par rapport aux crémaillères.

Il existe une plaque auxiliaire 157 (figure 8), pivotant sur le bout d'arbre 158 et munie d'une butée 159 en saillie latérale, qui chevauchera le bord supérieur du levier oscillant 132 quand ce dernier aura été soulevé à son extrémité arrière pour la position d'addition. Mais dans le cas de la soustraction, et quand le levier 132 est abaissé en dehors du passage, la plaque auxiliaire 157 oscille en avant à son extrémité inférieure sous la poussée du ressort à boudin 160, en sorte que l'encoche 161 voisine de son extrémité inférieure pourra venir en prise avec la butée 144, en saillie latérale, disposée à l'angle arrière de la plaque oscillante 141. Quand le levier 132 est amené à la position de soustraction, la saillie 144 s'introduira sous l'épaulement 161 aussitôt qu'elle sera libérée à la fin de la course en avant ce qui aura pour effet de maintenir mécaniquement les roues compteuses hors de prise avec les segments dentés (pendant la course de retour) jusqu'à ce que d'autres opérations soient intervenues, y compris la rotation de l'arbre 82 de la lanterne et le réenclenchement des cliquets 71 avec les ergots 72 correspondants, en vue de rétablir la liaison entre chaque segment denté, dans sa position normale, et son bras de bec de butée. La plaque oscillante 157 continue à caler la plaque 141 contre tout mouvement de retour, jusqu'à ce que la plaque principale 154 oscille en arrière d'une quantité suffisante pour amener l'ergot 162 contre l'extrémité inférieure inclinée de la plaque 157, après quoi ladite plaque se trouve dégagée et la plaque 141 est libre d'osciller en arrière sous la poussée de son ressort 146 qui, dès longtemps a été renvoyé de manière à exercer la tension dans l'autre sens.

Donc, le levier L étant dans la position d'addition, les pignons d'accumulateurs sont hors de prise au début de la course en avant et ils sont mis en prise au commencement de la course en arrière, tandis que, pour la soustraction, ils sont mis en prise au commencement de la course en avant, et hors de prise au début de la course en arrière, puis maintenus dégrenés mécaniquement jusqu'au début de la course en avant.

Afin d'amortir ou de rendre élastique l'oscillation du levier 137, son extrémité postérieure est disposée de manière à venir en prise avec des épaulements de la plaque coulissante 137′ mobile de bas en haut et de haut en bas et retardée par friction au moyen d'une plaque de retenue 137″ en métal à ressort, ayant des extrémités recourbées s'engageant dans les extrémités évidées de tiges 137″ sur lesquelles la plaque 137′ est montée à coulisse.

Il est essentiellement avantageux que le levier d'addition L cale d'abord la machine dès qu'il commence à osciller et qu'il la décale à la fin de son oscillation et que sensiblement tout le mouvement du levier 132 s'effectue pendant que la machine est calée. Pour produire ce résultat, le levier 132 comporte deux oreilles 131ᵃ et 131ᵇ séparées par un évidement central. Pendant le fonctionnement, et en supposant que les pièces se trouvent dans la position de la figure 11, suivant laquelle le levier d'addition est dans sa position arrière et l'extrémité avant du

levier 132 est abaissée, le levier d'addition peut osciller jusqu'à ce que le galet 131 ait dégagé l'oreille 131^a et dépassé l'espace central ouvert et qu'il soit venu effectivement en contact avec l'oreille 131^b avant que le levier 232 soit déplacé. La première partie de ce mouvement du levier L sert à caler la machine. Après avoir frappé l'oreille 131^b, le galet 131 communique d'abord au levier 132 une oscillation rapide et brève pour l'amener à sa position supérieure ou de soustraction; ceci se passe avant que le galet 131 puisse continuer son mouvement. Après que le levier 132 a été ainsi amené rapidement à sa position supérieure, le galet 131 peut ensuite continuer à tourner sur l'oreille 131^b sans exercer aucune action sur le levier 132. C'est cette partie du mouvement qui sert à décaler la machine. Le mécanisme de calage ou d'enclenchement du levier d'addition et de soustraction comprend la plaque oscillante 185 à laquelle est reliée rigidement la plaque 267 et dont l'angle arrière est disposé de façon à osciller transversalement au passage du bloc 186 disposé sur la plaque 154, lequel cale mécaniquement la machine.

Mécanisme totalisateur (figures 2, 3, 8 et 10). — Le mécanisme totalisateur comprend le levier des totaux T L monté à pivot sur l'arbre oscillant 163 et relié au levier d'addition et de soustraction L au moyen de la bielle 164 qui pivote sur le levier des totaux et qui est reliée au levier d'addition par une liaison à rainure et cheville 164' lorsque le levier T L est dans sa position arrière. Le levier L peut être rabattu soit en avant, soit en arrière sans entraver le levier T L, mais si ce dernier est rabattu vers le bas, il entraîne nécessairement avec lui le levier L, plaçant ainsi le mécanisme dans la position de soustraction, étant entendu que dans cette machine l'opération de totalisation est une opération de soustraction partielle et qu'elle comprend l'envidage en sens inverse des nombres précédemment inscrits ou leur retrait des roues compteuses. Le levier des totaux T L comporte en 165 une mortaise qui vient en prise avec l'extrémité de la bielle 166 dont l'autre extrémité pivote sur le plateau-came à bascule 167, dont la surface-came vient en prise avec le galet 168 porté sur l'extrémité inférieure du bras de manivelle 169 monté rigidement sur l'arbre oscillant 170. Ce dernier porte des crochets 171 (figure 10) dont les extrémités arrière servent de butée et qui sont disposés de manière à être rabattus circulairement en liaison par butée avec les dents 80^a dont l'une est portée sur l'arbre avec chaque roue compteuse 63 et sa roue porte-nombre 64. Les dents 80^a occupent un espace égal à un pas du pignon denté, et les pièces sont disposées de telle sorte que, quand les crochets 171 seront poussés en arrière, les dents 80^a amèneront les roues compteuses 63 à s'arrêter dans la position requise pour venir engrener avec la crémaillère 68. Quand il y a lieu de prendre un total, étant donné que le levier L est rabattu en avant, tous les pignons compteurs 63 viendront en prise avec la crémaillère 68 au début de la course en avant (comme pour une soustraction), les pignons 63 tourneront alors en arrière jusqu'à ce que les dents 80^a viennent frapper les crochets 171. Cette position correspond à la position zéro des roues de l'accumulateur. Comme le nombre de chacune de ces roues a été déroulé, les crémaillères sont arrêtées sur le nombre, quel qu'il soit, qui était enregistré sur les roues avant que l'opération commence. Si la roue compteuse portait un zéro enregistré au début de l'opération, sa dent 80^a serait, naturellement, déjà en contact avec le crochet 171 correspondant et la crémaillère intéressée ne pourrait pas démarrer. Donc le total sera expulsé de la machine et en même temps les crémaillères 68 seront placées dans une position qui correspondra au montant du total et ce dernier sera imprimé quand la machine sera mise au clair. Les pignons accumulateurs sont soulevés hors de prise à la course de retour des crémaillères 68, en sorte que, à la fin de l'opération, le total sera imprimé et la machine sera nette.

Il existe dans la plaque du levier des totaux T L, une mortaise 172 qui fait partie du mécanisme totalisateur, et se déplaçant dans cette mortaise, un galet fixé à l'extrémité d'un bras 173 monté rotativement sur un arbre oscillant 174 d'où part, dirigé vers l'arrière, un bras 175 monté rigidement (figure 2) et qui supporte la cornière 58, grâce à quoi, par l'action de la plaque verticale 57, l'arrêt du zéro est renvoyé chaque

fois qu'il y a lieu de prendre et d'imprimer un total ou un sous-total. Le bras 173 porte l'ergot 173^a qui vient en prise avec l'ergot 174^b du bras de manivelle 174^a, monté sur l'arbre 174, lorsque le bras 173 se déplace en sens inverse des aiguilles d'une montre, d'après la vue de la figure 8, le ressort à spirale 174^c agissant sur l'arbre 174 maintient normalement le bras 175 abaissé.

Le mécanisme totalisateur comprend également le bras oscillant 176, dont la face antérieure est conformée de façon à venir en prise avec l'ergot 177 en saillie sur la face externe du levier des totaux T L, ledit bras ayant pour fonction de pivoter sur la tige 176' et de transmettre un mouvement oscillant au bras 178 s'étendant vers le bas, lequel est incliné par rapport au bras 176, mais est obligé de tourner avec lui. L'extrémité inférieure du bras 178 comporte une mortaise et une came pour venir en prise avec le galet 179 qui, par l'intermédiaire de la manivelle 180 fait osciller le bras à bascule 26 (figure 3), grâce à quoi la lame 27 est rabattue de bas en haut contre les ergots 28 et entraîne la plaque de dégagement 20 de manière à renvoyer toutes les tringles d'arrêt en sorte que les becs d'arrêt ne seront gênés par aucun des mécanismes du clavier, mais seront libres d'osciller à la suite de la frappe des roues compteuses, ou, en d'autres termes, jusqu'à l'arrêt desdites roues par suite de la venue en prise des crochets 171 avec les butées 80^a.

Pendant que l'opérateur rabat le levier des totaux de sa position normale à sa position active, il est avantageux que la machine soit calée contre toute rotation et à cet effet on a prévu sur le bord inférieur de la plaque du levier des totaux T L, une came 181 sur laquelle roule le galet 181' porté par la manivelle coudée 182 qui agit en opposition à l'action du ressort 183 et sert à faire osciller le bras inférieur du levier coudé, contre le galet 184 en saillie sur le côté de la plaque de butée 185. Quand l'opérateur commence à rabattre en arrière le levier des totaux, la came 181 glisse sur le galet 181' et fait osciller de haut en bas la plaque 185 sur le passage de la plaque de butée 186 portée sur le côté de la plaque de réglage principale 154, qui agit comme un frein en vue de caler la machine contre toute rotation jusqu'à ce que le levier des totaux ait atteint approximativement sa position d'avant ou de fonctionnement et qu'il ait ainsi amené sa came 181 au-delà du galet de la plaque 182, à une distance suffisante pour permettre à la plaque de calage 185 de se soulever à nouveau pour dégager le passage.

Le bord inférieur de la plaque du levier des totaux est entaillé en 187 de manière que les épaulements qui en résultent puissent agir concurremment avec l'arbre 189 (qui porte le levier 132) pour limiter l'oscillation du levier des totaux.

Le levier sous-totalisateur présente la forme indiquée à la figure 14 et son bord inférieur est muni d'une surface came 190 en sorte qu'il peut également servir à faire osciller la manivelle coudée 182 et à chasser la plaque de calage 185 à sa position à l'avant de la plaque de réglage principale. Toutefois, cette saillie 190 du levier sous-totalisateur a une fonction supplémentaire, en ce sens qu'il peut se rabattre en avant pour venir au-dessus du bras 191 saillant en avant sur la plaque oscillante 141, servant ainsi à empêcher cette dernière d'osciller, indépendamment d'un déplacement du dispositif de tension. Donc, quand on prend un sous-total, les roues compteuses sont mises en prise avec les segments dentés et tournent jusqu'à ce qu'elles soient arrêtées, mais elles ne sont pas soulevées hors de prise pendant la course de retour. Il faut qu'elles tournent en arrière d'une même quantité et que par là elles reçoivent à nouveau le total qu'elles viennent de transmettre au mécanisme imprimeur. En d'autres termes, la saillie 190, en coopérant avec le bras 191 assure que le total qui a été relevé pour être imprimé sera retenu dans le calculateur; différant par là de l'opération faite quand le levier des totaux T L est seul abaissé, car dans ce cas, le total est extrait pour l'impression, et la machine est mise au net.

Le levier sous-totalisateur est relié au levier totalisateur T L par la tige 193 qui frappe contre un prolongement intérieur de la tige 177, en sorte que, bien que le levier des totaux puisse être poussé en avant sans entraver le levier des sous-totaux, il n'est pas possible de pousser ce dernier sans entraîner

en même temps avec lui le levier des totaux. C'est ce rabattement en avant du levier des totaux qui arrête tous les divers mécanismes totalisateurs et c'est le rabattement en avant du levier des sous-totaux qui cale la plaque oscillante 141 de façon à assurer le retour du total sur les roues compteuses.

Mécanisme de répétition (figures 3 et 8). — Pour assurer dans la machine la répétition des additions, des soustractions ou des impressions, sans effacer à chaque fois les chiffres du clavier, on a disposé à l'avant de la machine le levier répétiteur R L pivotant sur l'arbre court 194 et dont l'amplitude d'oscillation est limitée par l'ergot 195 qui se déplace dans une mortaise. L'angle inférieur 196 de cette plaque de levier oscillant porte un galet qui roule sur la surface came de la plaque 197 conformée irrégulièrement, qui pivote en 198 et dont l'extrémité arrière est pourvue d'une oreille 199 ayant pour fonction de s'abaisser contre l'extrémité antérieure de la barre 200, en chassant ladite barre de haut en bas en opposition à la tension de son ressort 201 de manière à la décaler de l'ergot 202 porté par la manivelle 203 montée sur l'arbre oscillant 23 qui a pour fonction de faire glisser la plaque de dégagement pour ramener les tiges des touches et les tringles d'arrêt à leur position normale.

L'arbre oscillant 23 étant ainsi rendu inactif, la frappe primitive des touches demeurera intacte et la machine pourra continuer à fonctionner autant de fois qu'il sera requis, additionnant ou retranchant et imprimant ladite frappe sans effacer le clavier. Au retour du levier oscillant 197 à sa position inactive, indiquée à la figure 8, la barre 200 se rabattra de bas en haut pour venir en liaison de commande avec l'ergot 202 et le clavier sera alors remis au net à chaque tour de la machine.

Afin de pouvoir caler la machine pendant que le levier répétiteur est amené de sa position haute à sa position basse, et également afin d'empêcher toute opération de la machine pendant que le levier répétiteur n'est pas exactement dans l'une ou l'autre de ces positions, on a établi sur le bord inférieur dudit levier une paire d'encoches, séparées par la face came 204, qui ont pour fonction d'appuyer de haut en bas sur l'extrémité du levier manivelle coudé 205 qui pivote sur l'arbre 206 et dont l'extrémité arrière inférieure est reliée par la bielle 207 à l'extrémité avant de la plaque de calage 185, grâce à quoi la plaque principale 154 peut être calée contre toute rotation. Le levier répétiteur étant dans sa position haute, l'extrémité à galet du levier 205 se trouve dans une encoche et la machine n'est pas calée, et, de façon analogue, quand le levier répétiteur est dans sa position basse, le galet se trouve dans l'encoche de l'autre côté de la surface came 204 et la machine n'est pas calée, mais pour toute position intermédiaire la manivelle coudée 205 est en dehors de sa position normale et la plaque de calage 185 dépasse vers le bas sur le passage de la plaque 186. La barre de calage 62' des divisions du clavier (figures 3 et 17) est portée par les leviers 205 et quand elle est abaissée, elle sert également à caler la machine contre toute rotation.

Élimination de nombres du calculateur (figures 8 à 12). — Afin d'imprimer divers nombres sur la feuille d'enregistrement, comme par exemple des numéros de wagons, sans les additionner sur l'accumulateur, on a prévu le levier éliminateur E L.

Normalement, ce levier est abaissé (figure 8). Il est monté à pivot sur la tige 194 et son bord inférieur est entaillé en vue de recevoir le galet de la plaque 205, il remplit donc la fonction de caler la machine contre toute rotation quand ledit levier n'est pas à la limite supérieure ou inférieure de sa course, son action correspondant, à cet égard, à celle du levier répétiteur R L. La partie essentielle qui assure l'impression d'un nombre sans qu'il soit additionné ou soustrait sur les calculateurs, consiste en un rouleau ou tige 208 qui tourne en se déplaçant le long du bord antérieur du bras oscillant 209 dont l'extrémité supérieure est fixée à pivot sur une longue barre de poussée 210, dont l'extrémité arrière est fixée à pivot en 211 à l'extrémité supérieure de la plaque oscillante 212 (figure 12), l'extrémité inférieure de cette dernière portant un crochet 213 qui a pour fonction de caler la butée 144 de la plaque 141 contre tout mouvement descendant. Le rôle de ce crochet consiste à empêcher tout mouvement de la plaque 141 indépendamment du déplacement de son dispositif de tension, empêchant ainsi toute

oscillation du bras qui porte les roues du calculateur et maintenant mécaniquement ces dernières contre leurs ergots de retenue 67.

Reliée également au pivot 211 à l'extrémité supérieure de ladite plaque, se trouve la barre de poussée 214 qui se prolonge vers l'arrière et vers le haut et dont l'extrémité externe est supportée et guidée par la tige 215 que reçoit une entaille de ladite barre de l'arbre 82. Cette barre 214 est entaillée de manière à passer au-dessus de la lanterne (qui sert à déplacer les segments dentés par rapport à leurs becs d'arrêt et à enclencher les cliquets pour maintenir ces deux pièces dans leur position relative normale).

La barre 214 porte l'épaulement 216 qui, lorsque la barre est poussée en arrière, vient en prise de calage avec l'ergot 217 porté par l'arbre 82 et maintient ainsi la lanterne contre toute rotation. La lanterne n'est pas mise positivement en rotation mais elle est simplement dégagée de sa position normale, oscillant suivant un arc limité grâce à un ressort (figure 19) et elle est fixée à nouveau par un dispositif à rainure et goupille commandé par l'arbre 155. L'épaulement 216 agit comme une détente pour empêcher le dégagement de la lanterne quand le levier éliminateur est soulevé. La pièce 214 est quelque peu superflue, car elle constitue une sorte de doublure de l'opération et de la fonction du crochet qui maintient la butée 144, et la machine peut être manœuvrée sans cette sauvegarde additionnelle.

Quand le levier éliminateur est soulevé dans sa position active, le bras oscillant 209 porte sur son bord arrière un ergot introduit à force sous l'épaulement de butée 218 établi sur le bord antérieur de la plaque de levier d'addition et de soustraction. Il en résulte que ladite plaque est calée dans la position d'addition, c'est-à-dire dans la position suivant laquelle les roues compteuses sont dégrenées d'avec leurs segments dentés, et le levier des totaux et celui des sous-totaux sont calés dans leur position normale par la bielle transversale 164. Il n'est pas possible de déranger de leur place normale aucun des deux leviers totalisateurs pendant que le levier éliminateur est dans sa position haute ou active. Un total porté sur la machine est donc garanti et ne peut être ni modifié ni éliminé.

Le levier d'addition et de soustraction L agit par l'intermédiaire de la manivelle coudée 219 pivotant sur l'arbre 176', de manière à déplacer la bielle 220 vers l'arrière, ladite bielle pivotant en 184 sur la plaque 185 et servant à chasser cette plaque de haut en bas sur le passage de la plaque 186 afin de caler la machine pendant que le levier d'addition et de soustraction est mis en mouvement, en sorte que la machine est calée pendant que se déplace le levier d'addition ou le levier totalisateur ou le levier répétiteur ou le levier éliminateur. Tous ces mécanismes de calage agissent par l'intermédiaire du bras descendant 267 de la plaque 185 en vue de régler les liaisons effectives entre le moteur et la machine. La machine est donc calée quand un mécanisme de réglage quelconque est soumis à un déplacement.

Réglage des butées du zéro. — La figure 9 montre également le mécanisme qui sert à régler les butées du zéro dans les mécanismes des touches. Il comprend une plaque 238 montée à pivot en 239 et munie de jambes 240 et 241 destinées à servir de butées pour limiter l'oscillation vers le haut et vers le bas de chaque extrémité de la plaque, en frappant contre la barre transversale 174. Au-delà de la division du clavier de l'autre côté de la machine, se trouve une plaque similaire 238', et ces deux plaques servent de supports aux barres transversales 56 et 37. La barre transversale 56, qui est portée sur les extrémités postérieures des plaques 238 et 238' agit de façon à abaisser la plaque 54 et à dégager du clavier la butée du zéro immédiatement après que le bec d'arrêt a frappé cette butée ou l'a dépassée, empêchant ainsi un retard dans le dégagement du bec d'arrêt dans le cas où une touche serait abaissée pendant la course en avant de la machine et plus tard, après que sa course en arrière est presque achevée, il sert à soulever la plaque verticale 54 et à retirer la butée du zéro. Ceci est utile dans les cas spéciaux où une touche a été abaissée pendant la course arrière et avant que la machine ait achevé son retour à la normale, la butée du zéro étant ainsi retenue en arrière de façon que la course en avant puisse commencer immédiatement. Si aucune touche n'a été abaissée pendant le mouvement en avant, le mouvement ascendant

de la barre 56 remettra en place l'ergot du zéro et le reliera à nouveau au clavier au moyen de la bielle 47 de telle sorte que l'abaissement ultérieur d'une touche puisse le chasser.

La barre transversale 37 (figure 3) se soulève sur les bielles à bascule 34 et, par là, supprime la liaison entre les touches de correction CK et les plaques de dégagement 20 pendant que la machine continue à tourner plus avant.

L'extrémité arrière de la plaque à bascule 238 est normalement poussée de haut en bas par le ressort à spirale 241' et ce mouvement descendant est réglé par la tige 242 en saillie sur le côté du disque 243 monté sur l'arbre de commande principal 155 de manière que, lorsque le disque 243 commence son oscillation en avant, la tige 242 s'écarte de la plaque 238 et permet à la barre transversale 56 de descendre, et ces organes demeurent dans cette position jusqu'à l'oscillation en retour de la plaque, la tige 242 soulevant alors à nouveau l'extrémité adjacente de la plaque à bascule 238. Ce mouvement abaisse et soulève la bielle coulissante 54 de façon à régler la butée du zéro comme il a été expliqué précédemment.

RÉSUMÉ.

L'invention a pour objet une machine à calculer, et elle est caractérisée essentiellement par le fait que :

1° Dans l'enveloppe sont montées une série de divisions amovibles portant chacune un mécanisme à touches amovibles avec elle en un tout, les divisions s'ajustant ensemble et pouvant, à volonté, être retirées de l'enveloppe sans que l'on enlève le mécanisme supportant les divisions en place dans l'enxeloppe.

2° Les divisions amovibles sont montées à coulisse sur des arbres transversaux, ou leur équivalent, qui en constituent le mécanisme de support.

3° Les divisions amovibles sont maintenues en place sur lesdits arbres au moyen d'un mécanisme démontable.

4° Une série de divisions sont montées amoviblement sur lesdits arbres et viennent en prise avec eux suivant un mouvement coulissant, et elles portent un mécanisme à touches amovible avec elles.

5° Le mécanisme accumulateur comprend des dispositifs de report manœuvrables par les divisions amovibles du clavier et munis de systèmes qui en empêchent l'action de report, afin que les divisions coopérantes du clavier puissent être retirées sans affecter le fonctionnement de la machine.

6° Chacune des divisions du clavier constitue un tout, et leurs touches commandent des dispositifs calculateurs de telle sorte qu'une division quelconque peut être retirée de la machine sans affecter le fonctionnement d'aucune autre division.

7° Le mécanisme calculateur est composé de divisions montées chacune amoviblement et dont les pièces sont reliées entre elles d'une manière démontable, chaque division comportant une roue de calculateur disposée de façon à tourner en sens opposés pour l'addition et pour la soustraction.

8° Chacune des roues du calculateur comporte une crémaillère qui fait tourner les roues dans l'un ou l'autre sens, et les crémaillères et les roues sont mises en prise et hors de prise en différents points du cycle opératoire de la machine.

9° Le mécanisme calculateur est disposé par divisions dont chacune comprend une plaque portant un élément du mécanisme de report et comporte des mortaises à extrémité ouverte qui, coulissent sur des arbres oscillants, dans un sens transversal à la longueur des arbres, en sorte que les plaques et les éléments de report qui y sont fixés peuvent, au choix, être retirés ou interchangés.

10° Chaque rangée de touches numérotées est reliée à un mécanisme particulier, afin de rappeler une touche abaissée, et le fonctionnement de chaque mécanisme de rappel, lequel comprend de préférence une touche combinée avec chaque rangée de touches numérotées, est commandé indépendamment des autres.

11° Il existe un bec d'arrêt oscillant sur le passage duquel une tringle d'arrêt est maintenue élastiquement après qu'une touche a été abaissée grâce aux liaisons entre ladite touche et la tringle d'arrêt.

12° Lesdites liaisons permettent au bec d'arrêt d'osciller vers l'arrière au-dessus des tringles d'arrêt coopérantes, en les écartant alors que leurs touches respectives sont encore abaissées.

13° Une touche est maintenue abaissée par une butée oscillante et il existe une liaison oscillante entre ladite butée et une tringle d'arrêt, en vue de permettre le mouvement 5 de la tringle pendant que la touche est abaissée.

14° La liaison oscillante est isolée de la butée oscillante ou mobile indépendamment de cette dernière.

10 15° Le dispositif à touches porte un ergot disposé de façon à être mis en prise avec un étrier oscillant amené de force à la position d'arrêt; une selle susceptible d'osciller avec l'étrier pivotant sur une tringle d'arrêt et 15 étant susceptible également de se mouvoir indépendamment de l'étrier.

16° Une touche est maintenue abaissée par un mécanisme de butée qui coopère avec la tige de touche et en même temps, com-20 mande la tringle d'arrêt, de telle sorte que chaque tringle d'arrêt peut être rendue indépendante de la touche qui la commande en vue de retirer les tringles d'arrêt de leur position d'arrêt indépendamment de la position 25 de leurs tiges de touche respectives.

17° Les tringles d'arrêt sont commandées par les tiges de touche, et un dispositif, tel qu'une plaque coulissante, fait osciller les éléments de liaison entre les tringles et les tiges, 30 de manière à renvoyer mécaniquement les tringles d'arrêt et à libérer des touches abaissées.

18° Une plaque coulissante ou son équivalent, correspond à chacune des divisions 35 d'un clavier sectionné, et chaque plaque coulissante comporte une touche de correction destinée à libérer toutes les plaques abaissées d'une division quelconque, indépendamment des autres divisions.

40 19° Le mécanisme accumulateur est combiné avec des becs d'arrêt dont la position est rendue indépendante du dispositif qui normalement détermine leur position, au moyen d'un mécanisme qui est rendu inopérant pen-45 dant une partie de chaque cycle opératoire de la machine.

20° Une tringle d'arrêt du zéro est disposée de manière à être amenée à la position d'arrêt immédiatement après que son bec 50 d'arrêt l'a dégagée au cours de son oscillation en avant.

21° Des becs d'arrêt sont combinés avec des crémaillères destinées à commander des pignons de l'accumulateur, chaque crémaillère et le bec d'arrêt correspondant étant normale- 55 ment maintenus solidairement en mouvement, tout en ayant un certain mouvement relatif l'un par rapport à l'autre, dans l'un ou l'autre sens du mouvement.

22° La crémaillère et le bec d'arrêt sont 60 commandés de manière à se mouvoir solidairement, au moyen d'un cliquet qui, lorsqu'il est dégagé, permet à la crémaillère de se déplacer au-delà du bec d'arrêt.

23° La crémaillère, le bec d'arrêt et le cli- 65 quet sont à nouveau immobilisés après que le mouvement de la crémaillère, par rapport au bec d'arrêt, s'est achevé.

24° Un organe d'arrêt fixe limite la course du bec d'arrêt dans un sens, et des dispositifs 70 manœuvrables par sélection limitent la course du bec d'arrêt dans l'autre sens, en des points variables.

25° Un levier porte un caractère à une extrémité et un bec d'arrêt à l'autre extrémité, 75 et est porté par un arbre à bascule qui porte également un bras de crémaillère, une liaison à friction étant établie entre l'arbre à bascule et le levier et entre l'arbre à bascule et le bras de crémaillère. 80

26° Le levier porte-type est maintenu élastiquement à son support, et ce dernier oscille de manière à faire osciller ledit levier et son signe ainsi que le bras de crémaillère, grâce à une disposition telle que le mouvement du le- 85 vier porte-type est retardé ou entravé à la fin du mouvement de retour de l'arbre à bascule.

27° Un secteur denté est combiné avec chaque roue compteuse en vue de faire tourner celle-ci d'une quantité déterminée, et le 90 fonctionnement du secteur denté est réglé par un bras à commande par touche combiné avec le secteur, chaque secteur étant relié à cheville et mortaise avec le bras correspondant, de façon à permettre au secteur de se 95 déplacer d'un espace dans l'un ou l'autre sens indépendamment du bras correspondant, chaque secteur étant normalement encliqueté sur le bras correspondant en vue d'un fonctionnement simultané, et le dispositif d'encli- 100 quetage étant relié à la roue compteuse en sorte qu'une roue d'ordre inférieur, en passant par le zéro, dégage automatiquement le secteur d'une roue d'ordre supérieur, en vue de

reporter une unité sur cette dernière, suivant une disposition telle que tout secteur requis peut être calé contre tout dégagement afin d'empêcher un report par ledit secteur.

28° Le levier porte-type est monté entre une bobine et un disque qui sont maintenus élastiquement assemblés sur l'arbre à bascule de façon à osciller avec lui et à commander à friction le levier porte-type, le bras de crémaillère venant en prise, de préférence par friction. avec l'autre côté du disque.

29° Une paire d'organes à friction sont montés sur un arbre et viennent maintenir à friction entre eux un bras destiné à faire manœuvrer un dispositif calculateur, lesdits organes étant chassés l'un contre l'autre élastiquement.

30° L'accumulateur comprend un certain nombre de divisions amovibles chacune en un tout sans déranger les autres divisions; une came adjacente à chaque roue compteuse coopère avec l'une des divisions en vue de décliqueter cette dernière quand il ya lieu d'effectuer un report d'une division sur la suivante.

31° Un mécanisme de report agissant sous l'action des roues compteuses, fait glisser les crémaillères par rapport aux becs d'arrêt, dans un sens ou dans l'autre, de manière à effectuer le report à travers la machine, dans un sens ou dans l'autre, d'une roue compteuse sur la suivante.

32° Un levier mobile à renversement, ou son équivalent, est combiné avec un mécanisme qui met un pignon en prise ou hors de prise avec une crémaillère oscillante alors que la crémaillère se trouve au commencement ou à la fin de son oscillation en avant.

33° Un dispositif de réglage dudit levier oscillant, et les liaisons entre le dispositif et le levier, sont tels que le premier peut se déplacer, de la position correspondant à l'un ou l'autre arrêt du levier, sensiblement jusqu'à une position correspondant à l'autre arrêt du levier, sans déranger ce dernier, la machine étant calée pendant le déplacement du levier de réglage.

34° Les pignons sont mis en prise avec les crémaillères au moyen d'un dispositif à tension de ressort, de préférence commandé par une plaque qui oscille avec un arbre de commande principal, le dispositif à tension étant combiné avec un mécanisme de dégagement qui coopère avec la plaque oscillante en vue de déplacer les pignons par rapport à leurs crémaillères, au moment requis.

35° Le mécanisme de mise en prise est calé de telle sorte qu'aucune addition ni soustraction ne peut s'effectuer durant le mouvement oscillant des crémaillères.

36° Les organes totalisateurs comprennent un dispositif qui peut être placé dans la position requise pour être saisi par des organes d'arrêt montés sur les pignons compteurs, lesquels pignons sont mis en prise avec des crémaillères oscillantes au début de leur oscillation, les tringles d'arrêt étant retirées en sorte que la commande des crémaillères se déplace des becs d'arrêt jusqu'aux dispositifs d'arrêt et les crémaillères sont arrêtées à une position correspondant au total, tandis que la machine est remise au net.

37° Des tringles d'arrêt du zéro et des tringles d'arrêt correspondant aux neuf autres chiffres, sont combinées avec un mécanisme manœuvrable par un organe totalisateur, en vue de retirer les tringles d'arrêt et les tringles d'arrêt du zéro quand il y a lieu de prendre un total.

38° Un mécanisme duplicateur est disposé de manière à être arrêté en concordance avec l'arrêt de bras de becs d'arrêt qui sont réglables au moyen de tringles d'arrêt commandées par sélection, par le clavier, et les bras de becs d'arrêt sont arrêtés en concordance avec l'arrêt du mécanisme duplicateur.

39° Le mécanisme duplicateur comprend des pignons munis de butées, lesquels pignons sont mis en prise avec des dents de crémaillère sur les bras de becs d'arrêt pendant un mouvement de ces dents, de manière à écarter les butées du pignon d'autres butées qui leur sont adjacentes, et sont mis en prise avec ces dernières pendant un autre mouvement des mêmes dents, en sorte que les butées sont amenées en contact, par sélection, en vue de limiter le mouvement des bras de becs d'arrêt en concordance avec l'arrêt des butées du duplicateur.

40° Les tringles d'arrêt du zéro sont retirées simultanément avec la mise en prise des pignons du duplicateur avec les bras des becs d'arrêt en sorte que le réglage est effectué par lesdits pignons du duplicateur.

41° Les bras de becs d'arrêt qui sont com-

mandés par sélection, au moyen de dispositifs de frappe de touches, comportent des dents de crémaillère, avec lesquelles les pignons du duplicateur sont mis en prise au début de la course en arrière desdites dents.

42° L'amplitude du mouvement des bras de becs d'arrêt est limitée de façon variable par des dispositifs de frappe de touches, un nombre frappé par lesdits dispositifs étant mis en réserve sur les pignons du duplicateur, puis reporté à nouveau sur les bras de becs d'arrêt et soit effacé soit maintenu sur les pignons du duplicateur.

43° Un mécanisme duplicateur comprend des pignons disposés de manière à osciller jusqu'à venir en prise ou hors de prise avec des dispositifs de commande oscillants et à être maintenus effectivement, par sélection, en prise ou hors de prise simultanément avec l'application d'une tension au mécanisme duplicateur, en vue de le faire coulisser en sens inverse, le mécanisme qui maintient les pignons étant entraîné à la fin du premier demi cycle opératoire de la machine, en sorte que les pignons sont, suivant le cas, mis en prise ou hors de prise.

44° Un mécanisme totalisateur à commande par ressort et un levier d'addition et de soustraction destiné à mettre le mécanisme calculateur en action ou hors d'action pour additionner ou soustraire, sont disposés de telle sorte que les organes sont renvoyés à leur position normale après l'achèvement de l'addition ou de la soustraction, les pièces étant calées dans leur position appropriée tandis que les mécanismes calculateurs achèvent leurs opérations, et étant ensuite libérés de manière à permettre l'action dudit ressort.

45° Un mécanisme de report, combiné avec une série de roues compteuses, consiste en des divisions amovibles indépendamment les unes des autres, et il existe une division pour chaque roue compteuse, sauf pour celle de l'ordre le plus élevé.

46° Une crémaillère à commande par touche est combinée avec chaque roue compteuse en vue de la manœuvrer, et est manœuvrée elle-même en vue de remettre la roue au net, cette dernière étant combinée avec un bras d'arrêt à commande par touche.

Société dite : THE TECTOR COMPANY.

Par procuration :

Ch. de Mosenthal.

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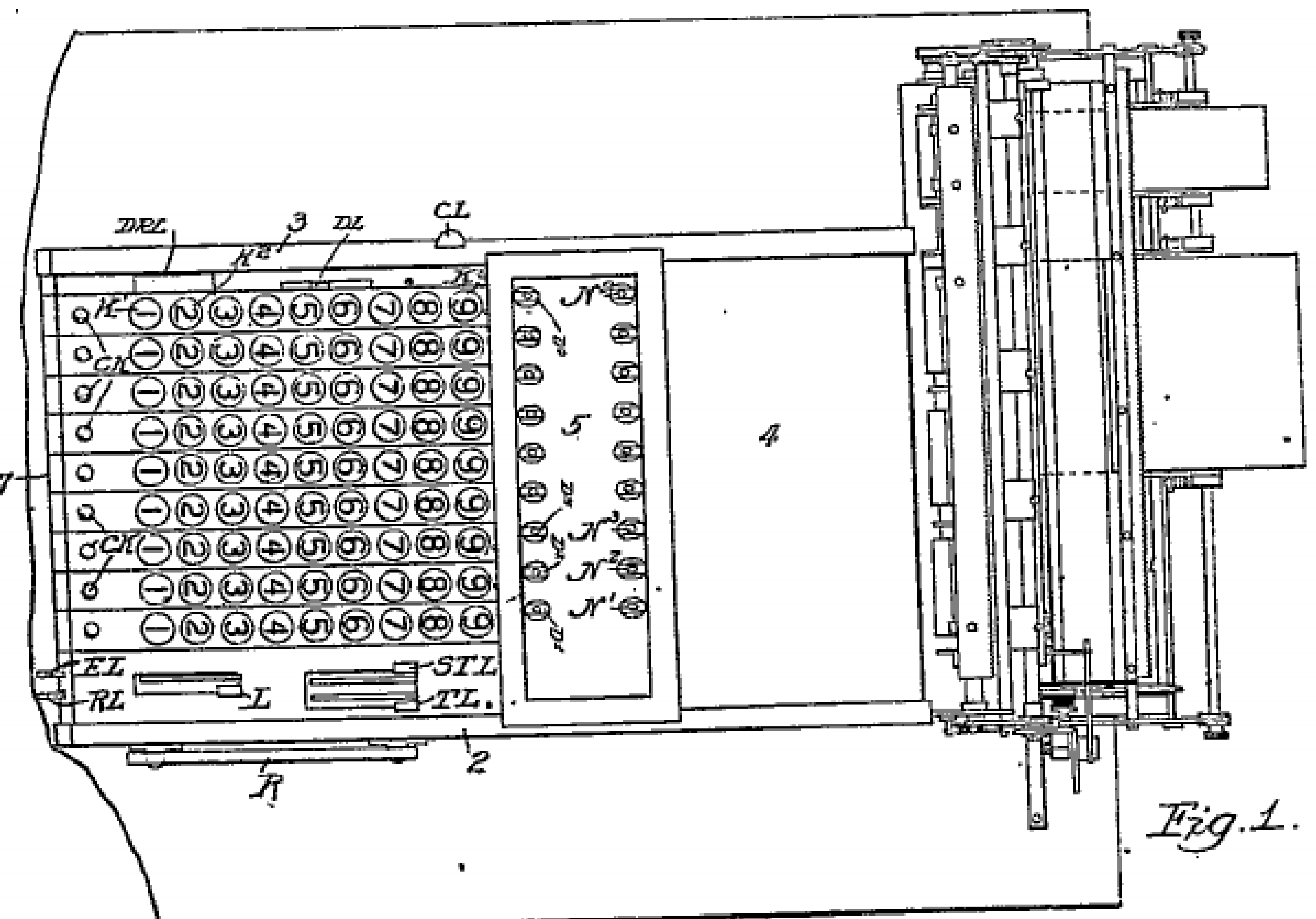


Fig. 1.

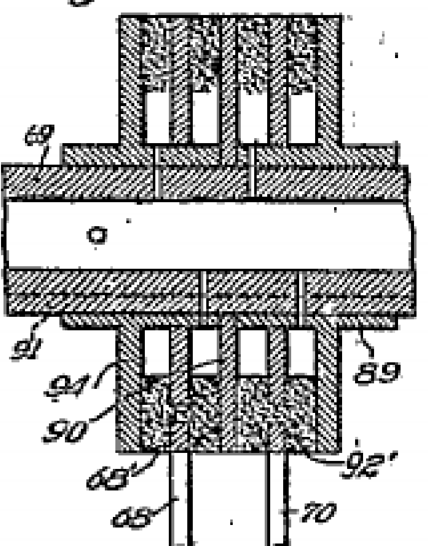


Fig. 18

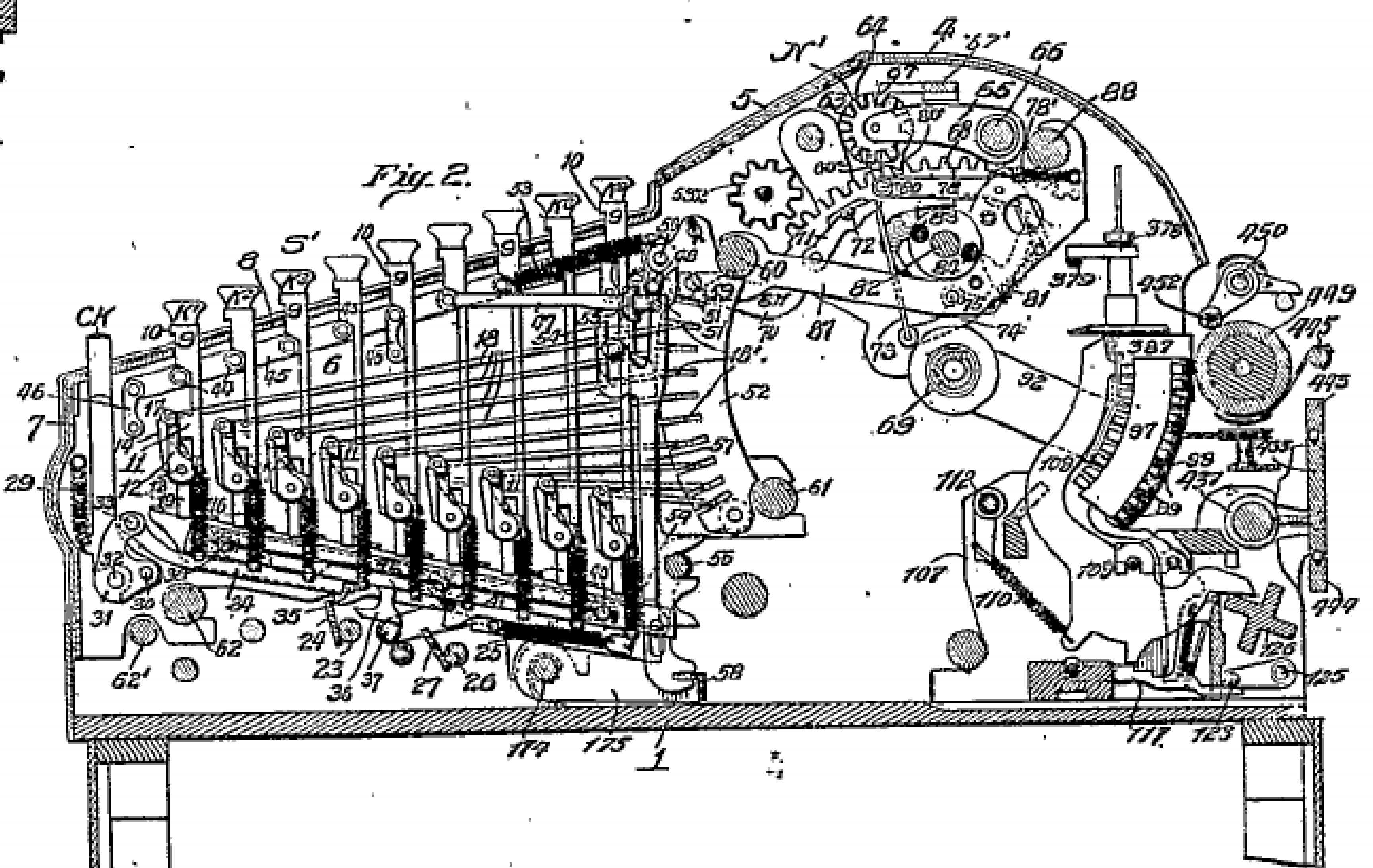
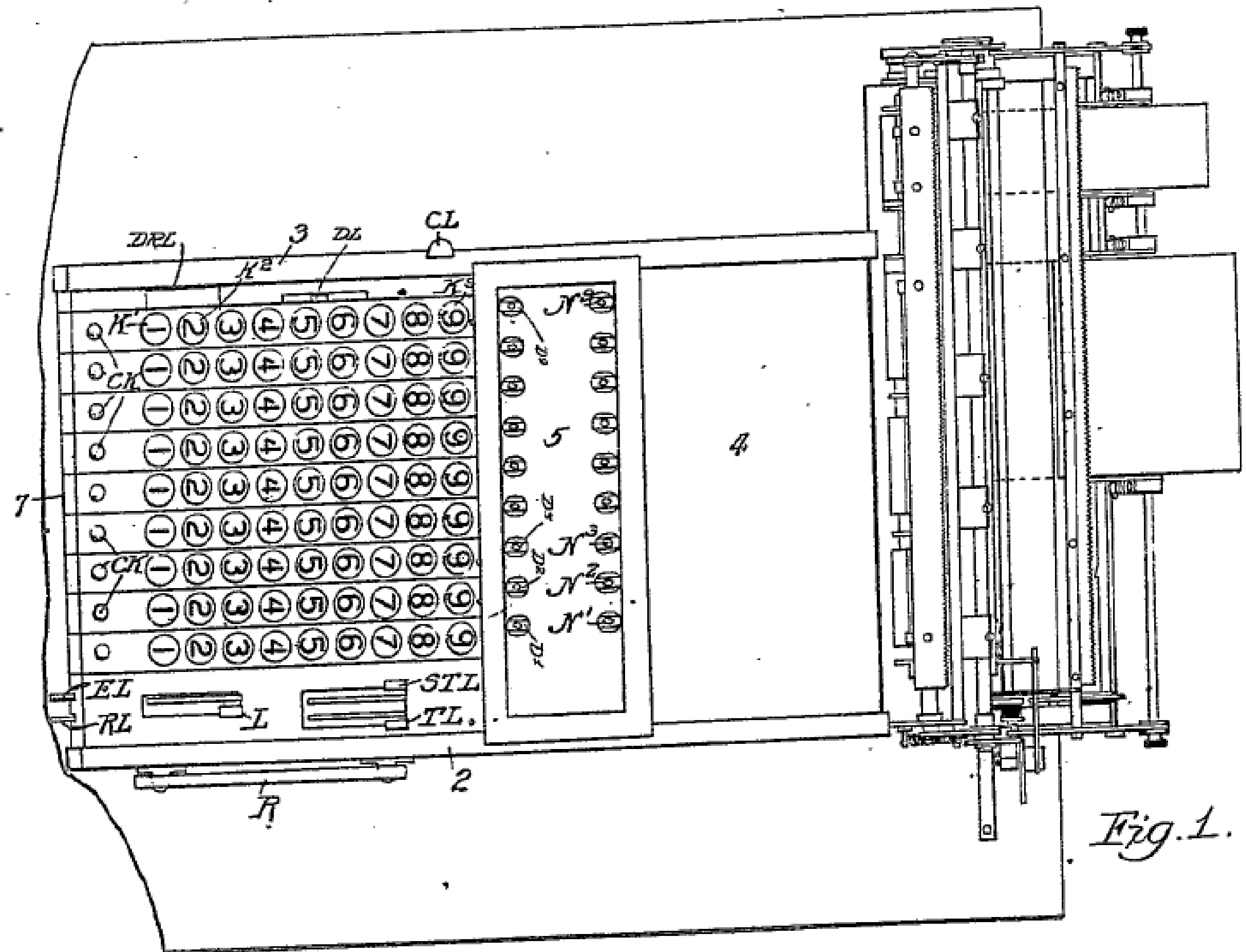
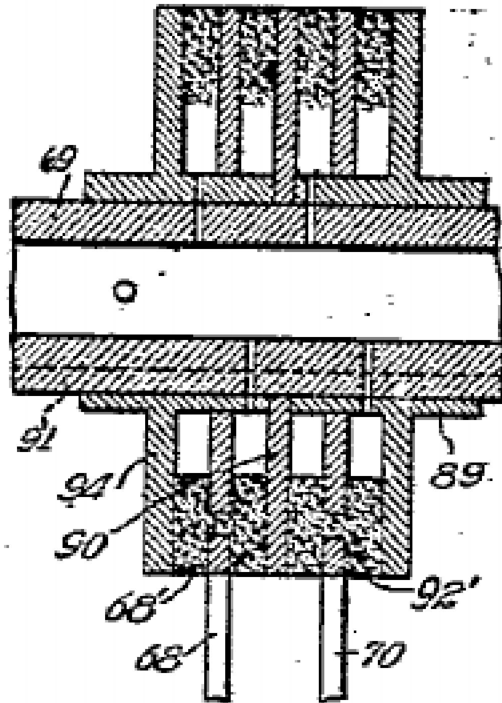
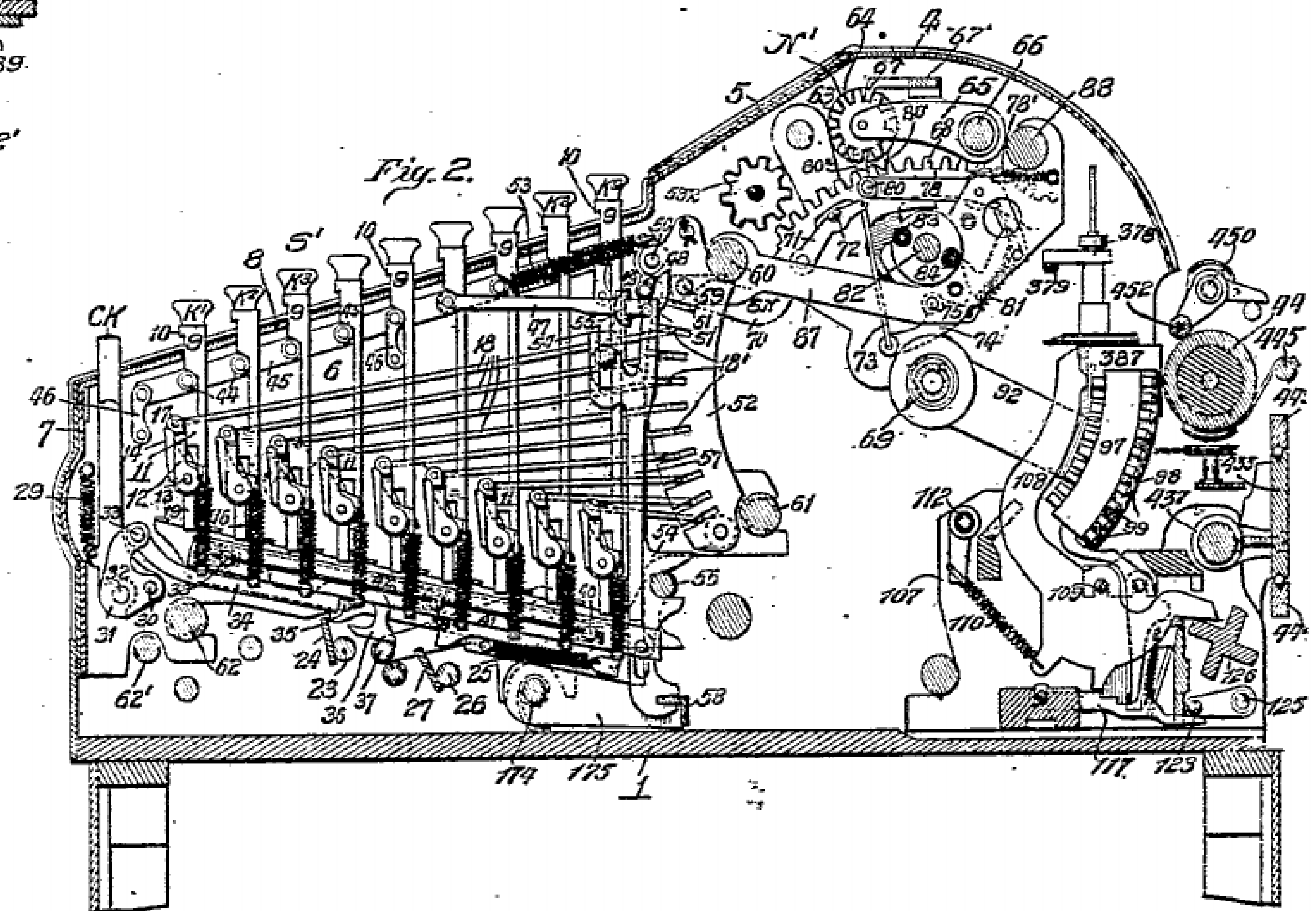


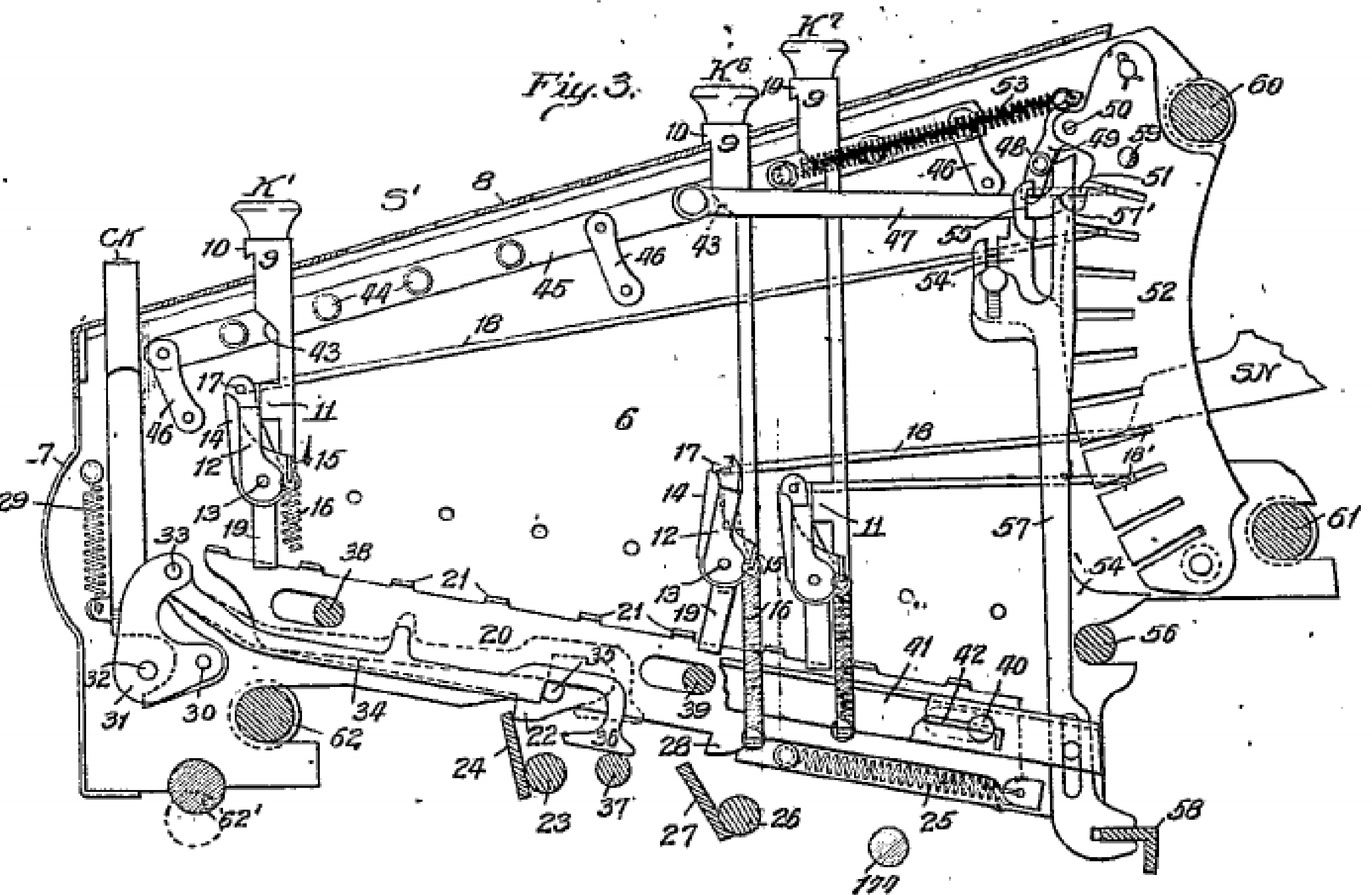
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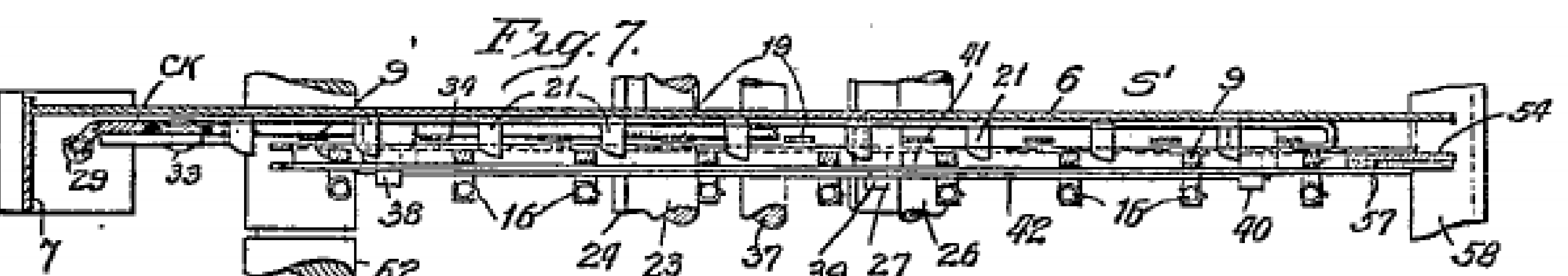


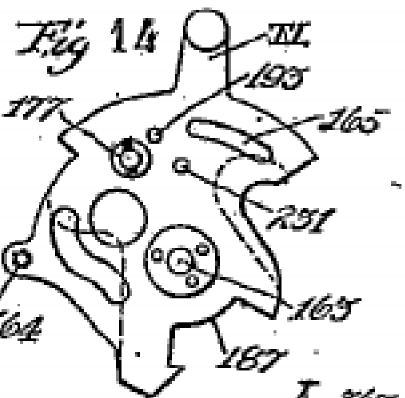
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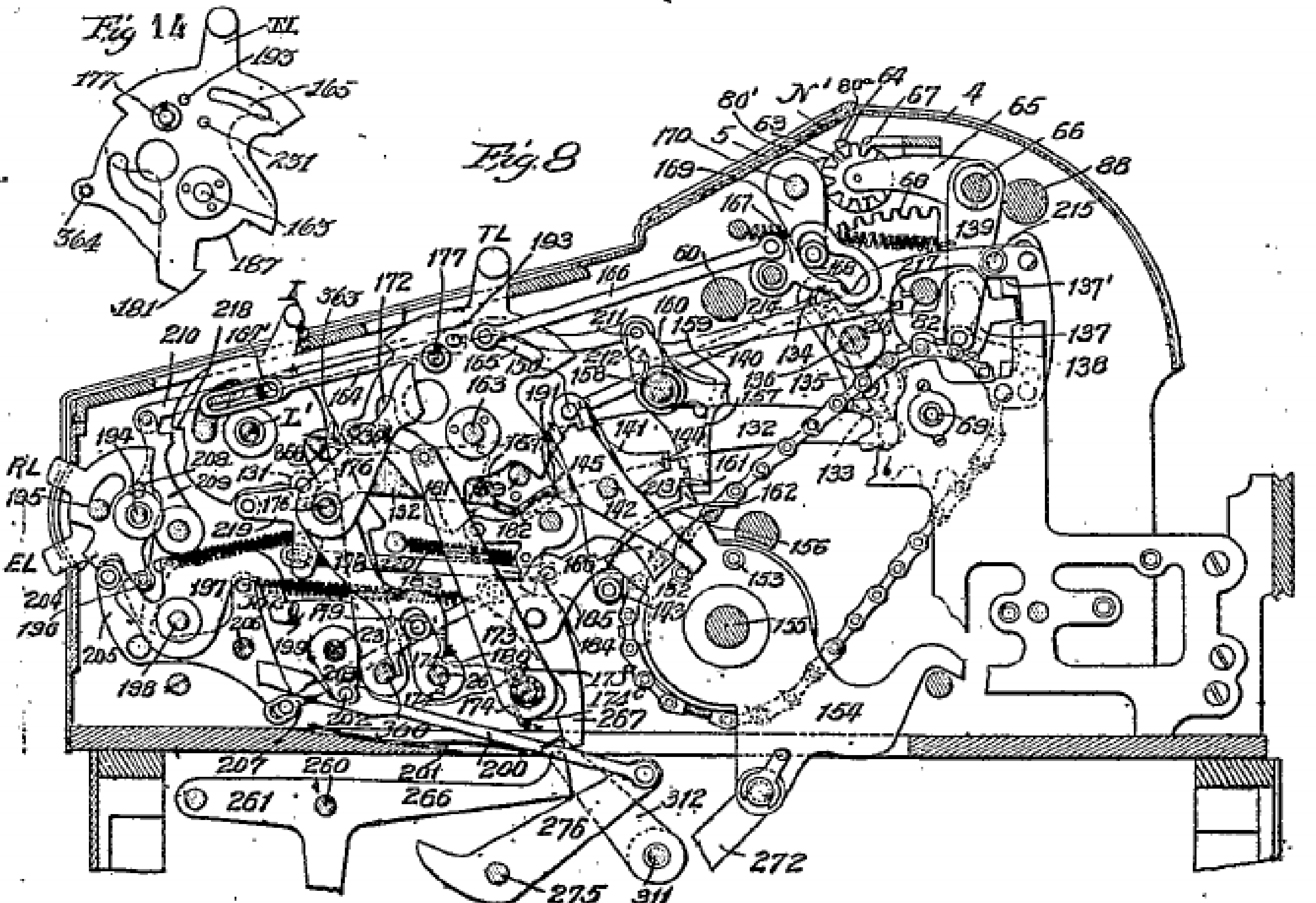

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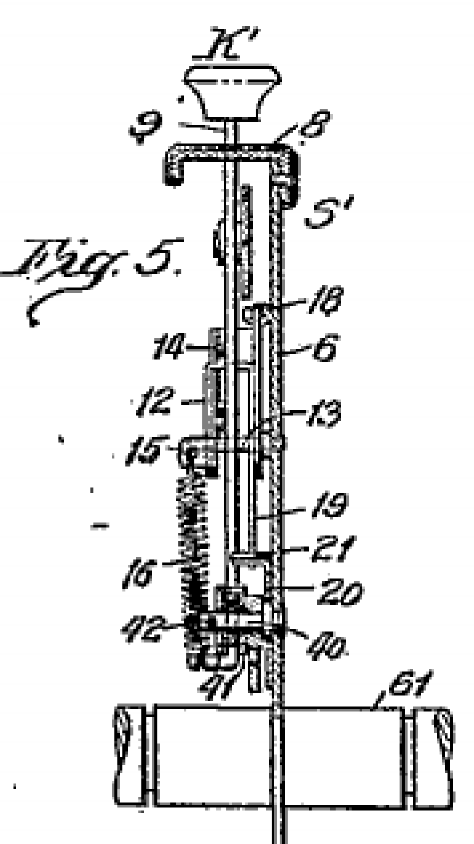

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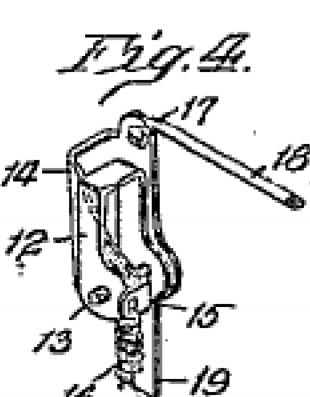

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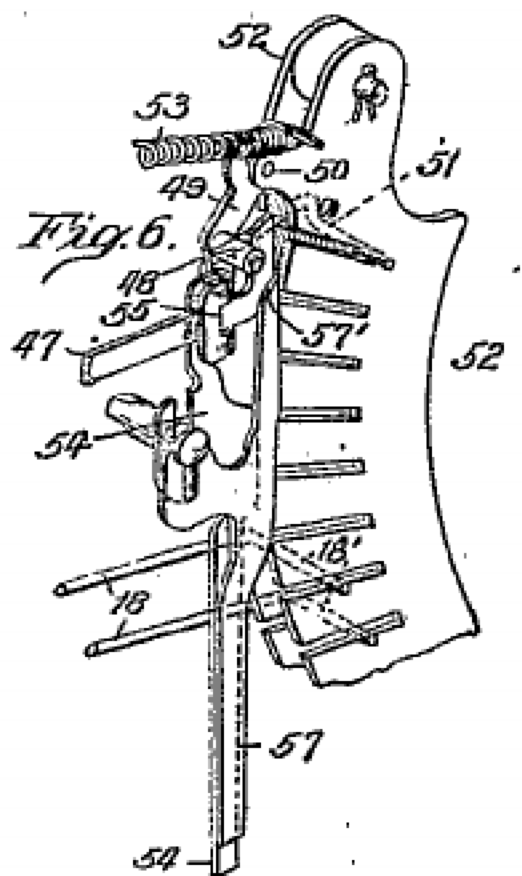

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Fig. 14

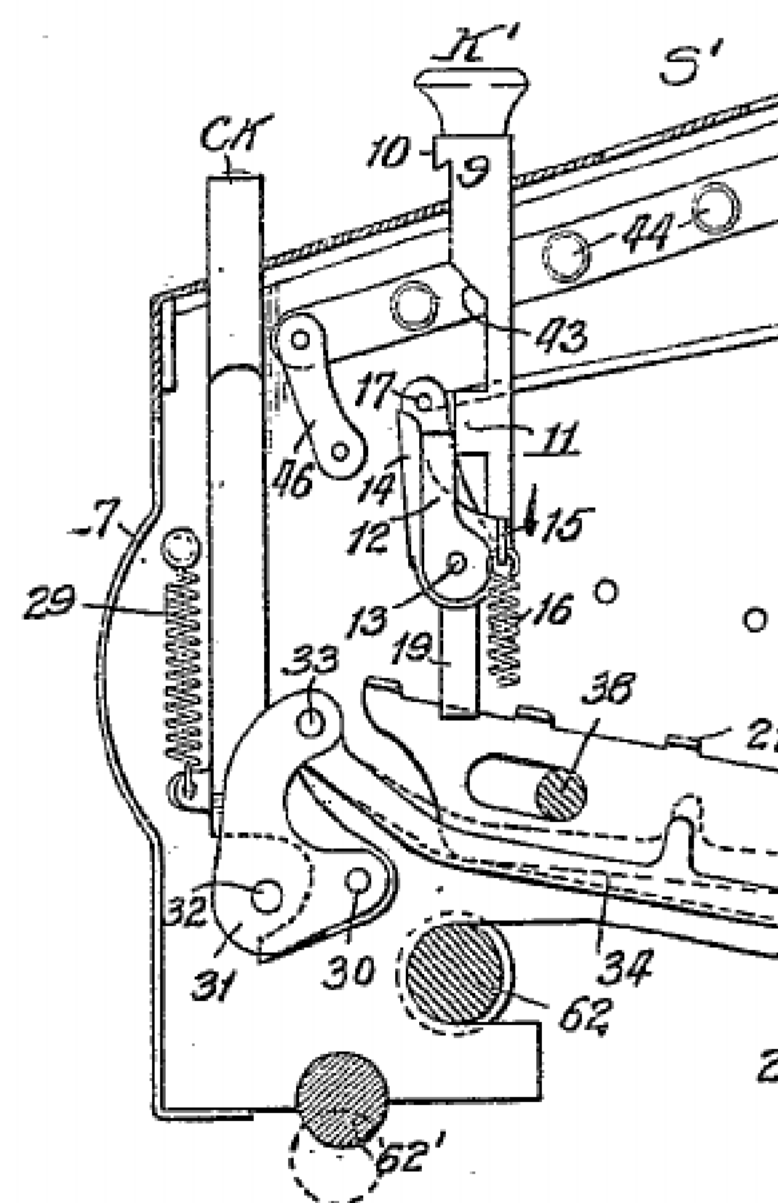

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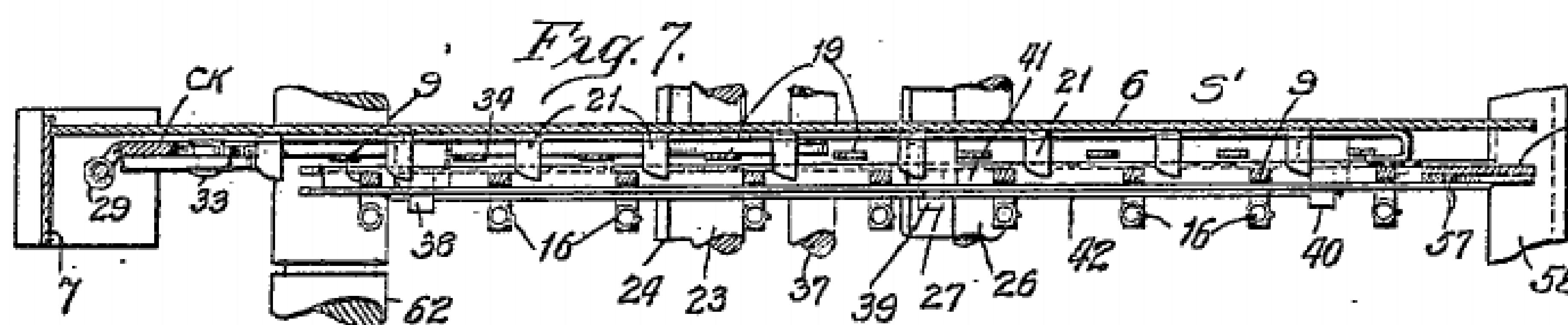

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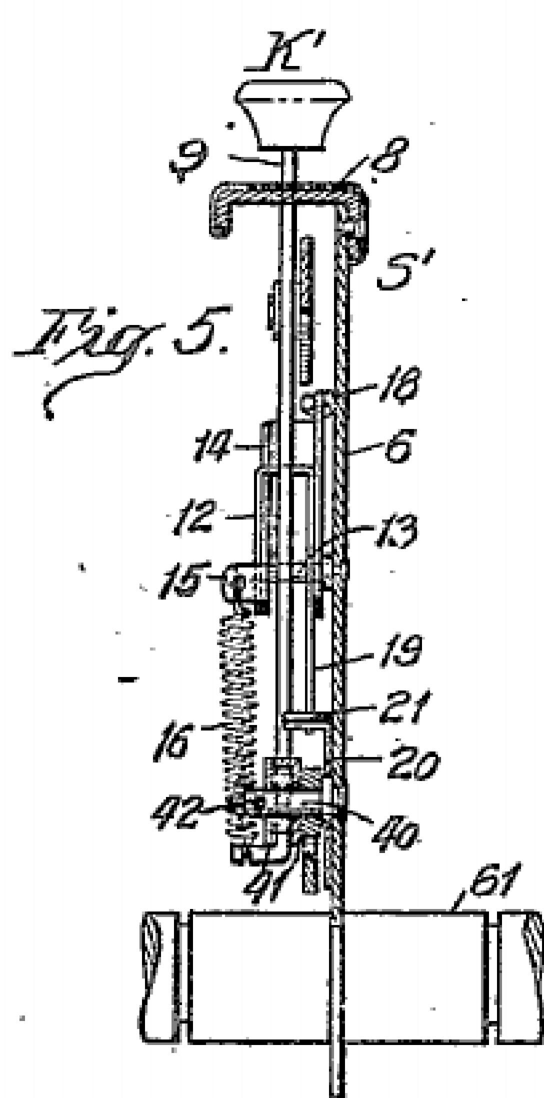

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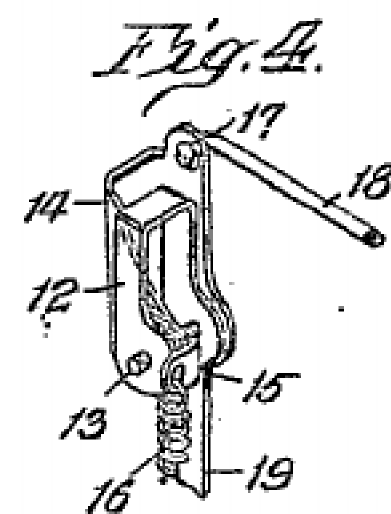

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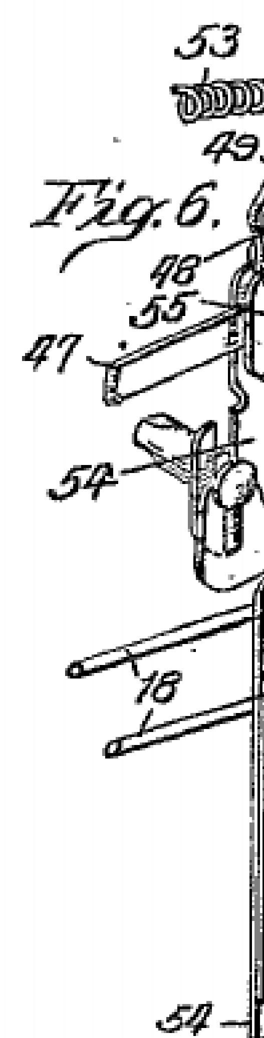
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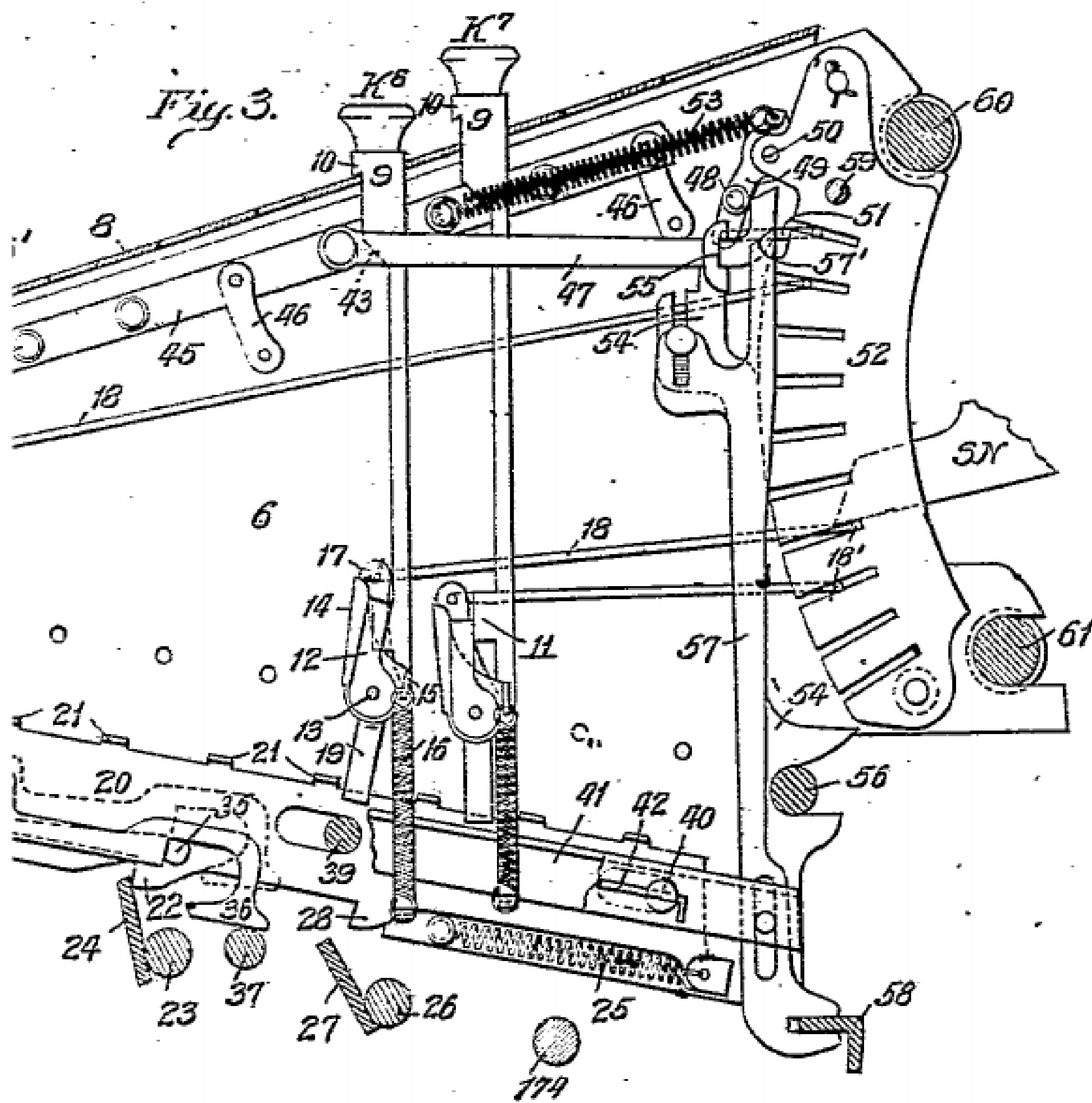


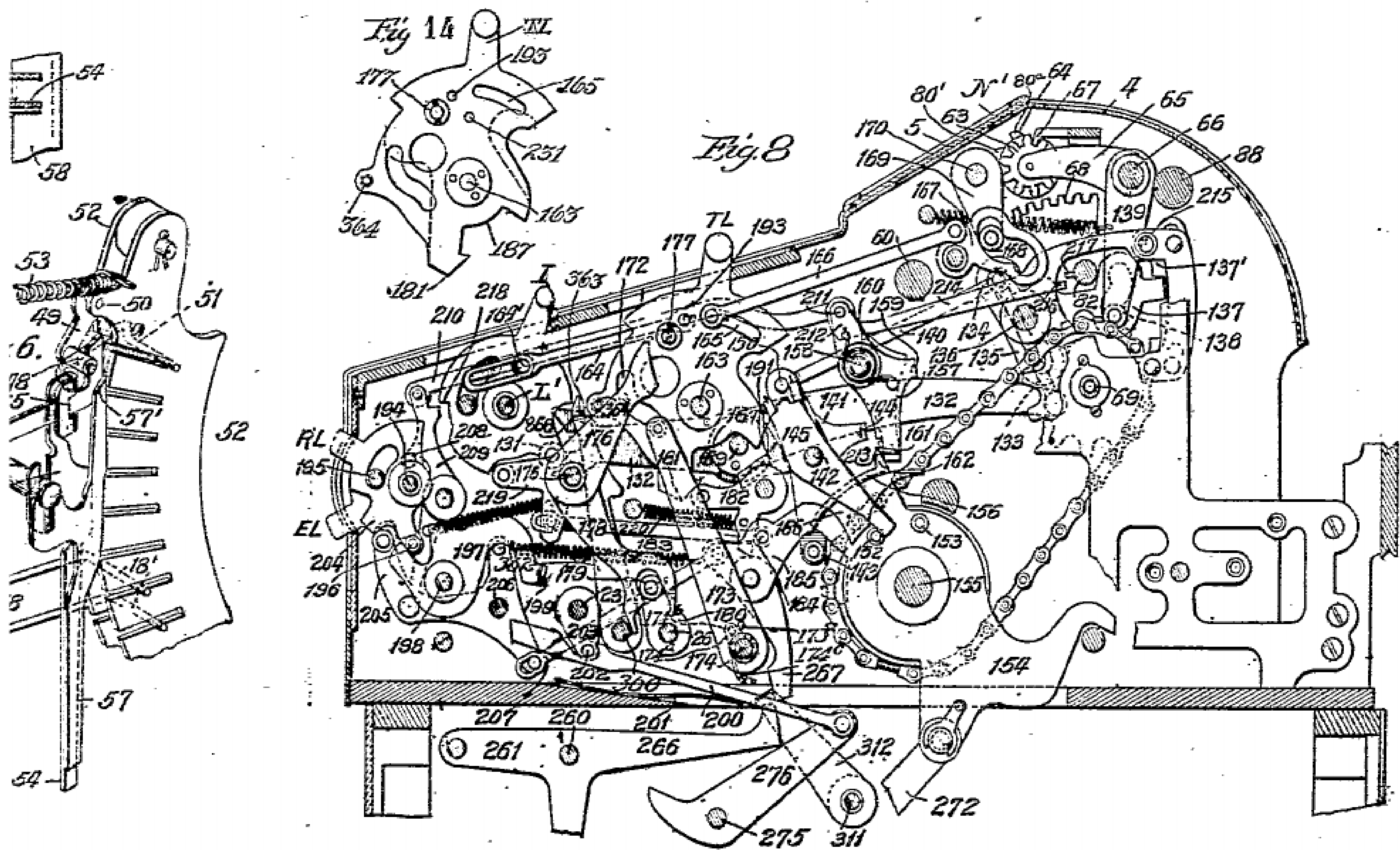




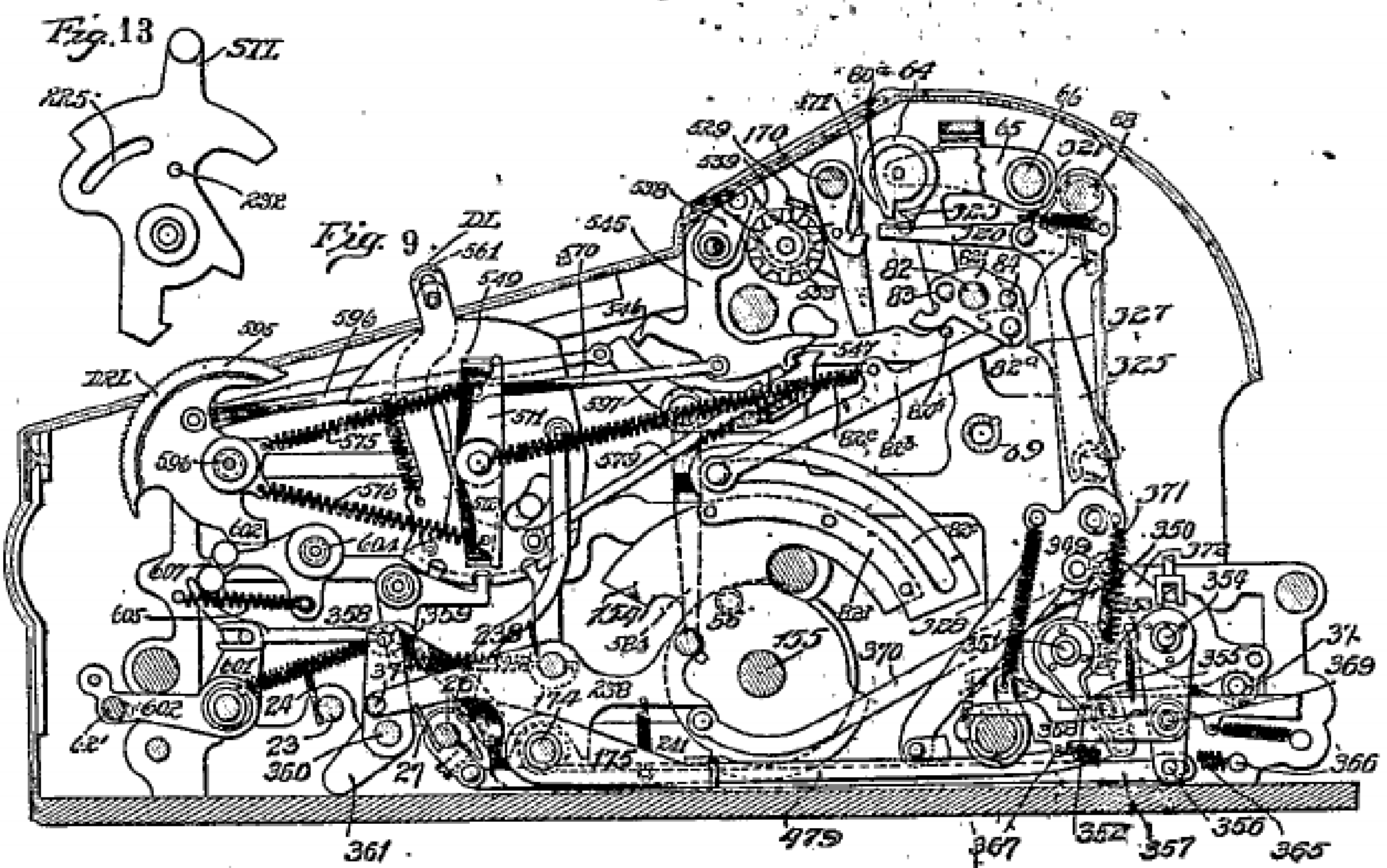


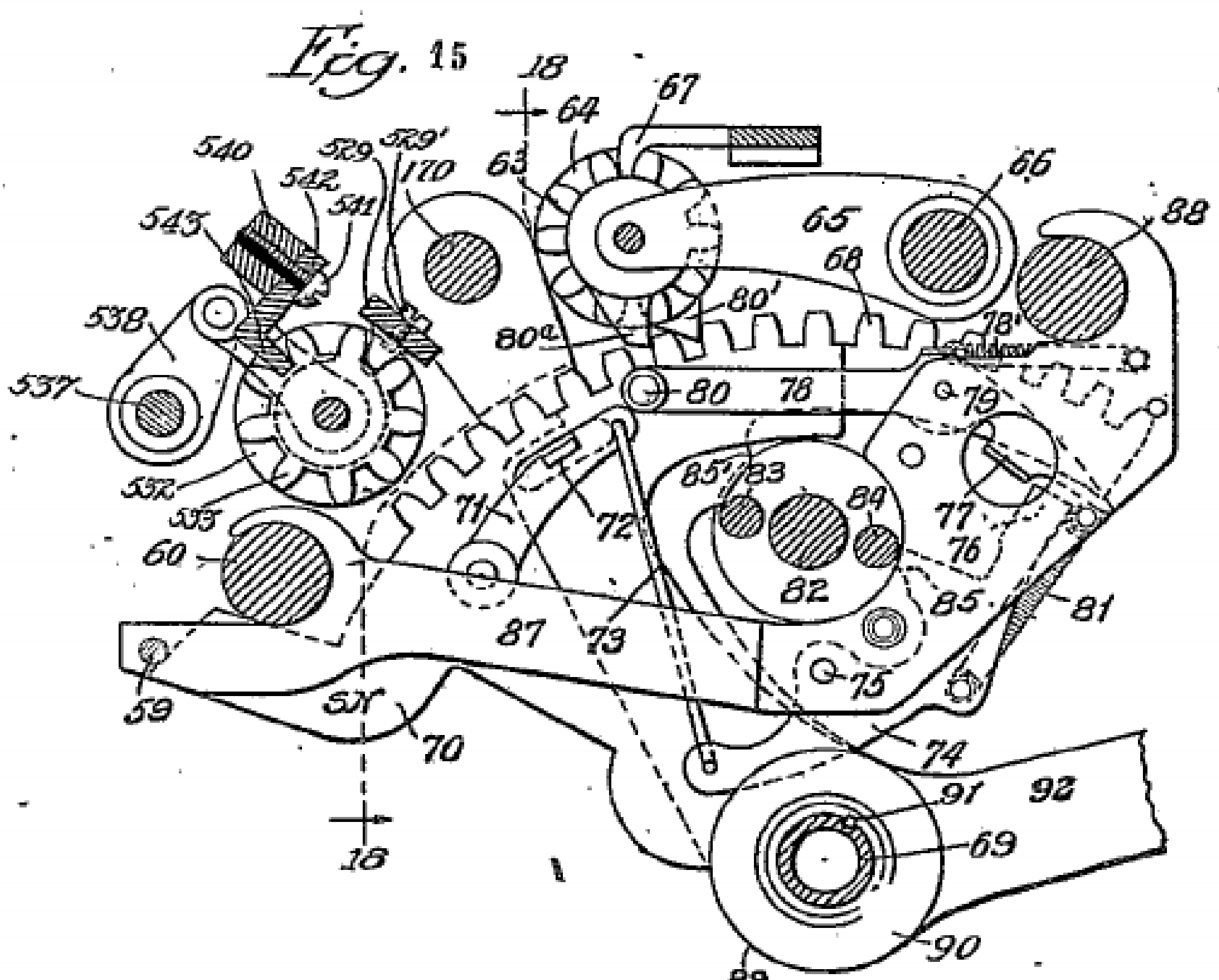
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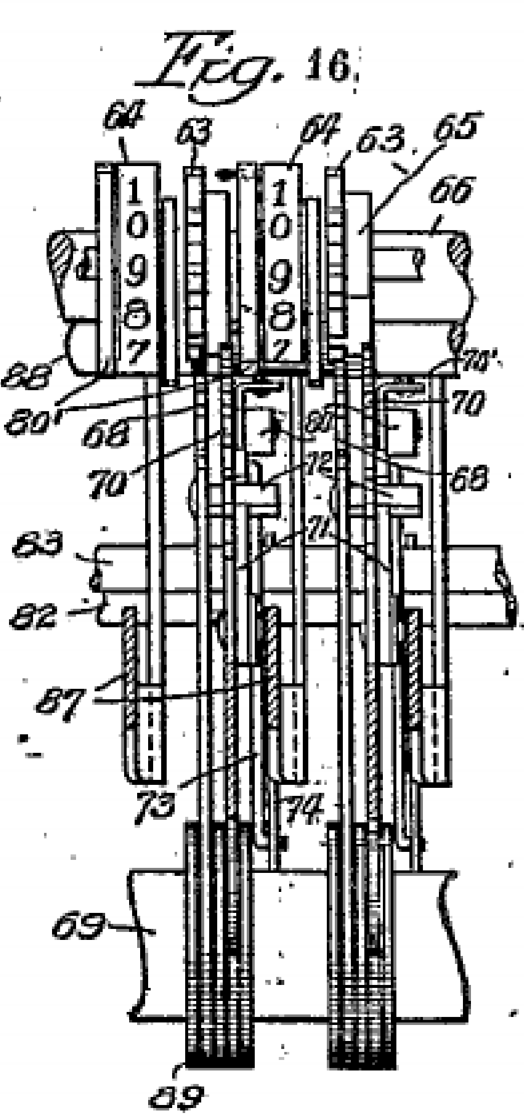


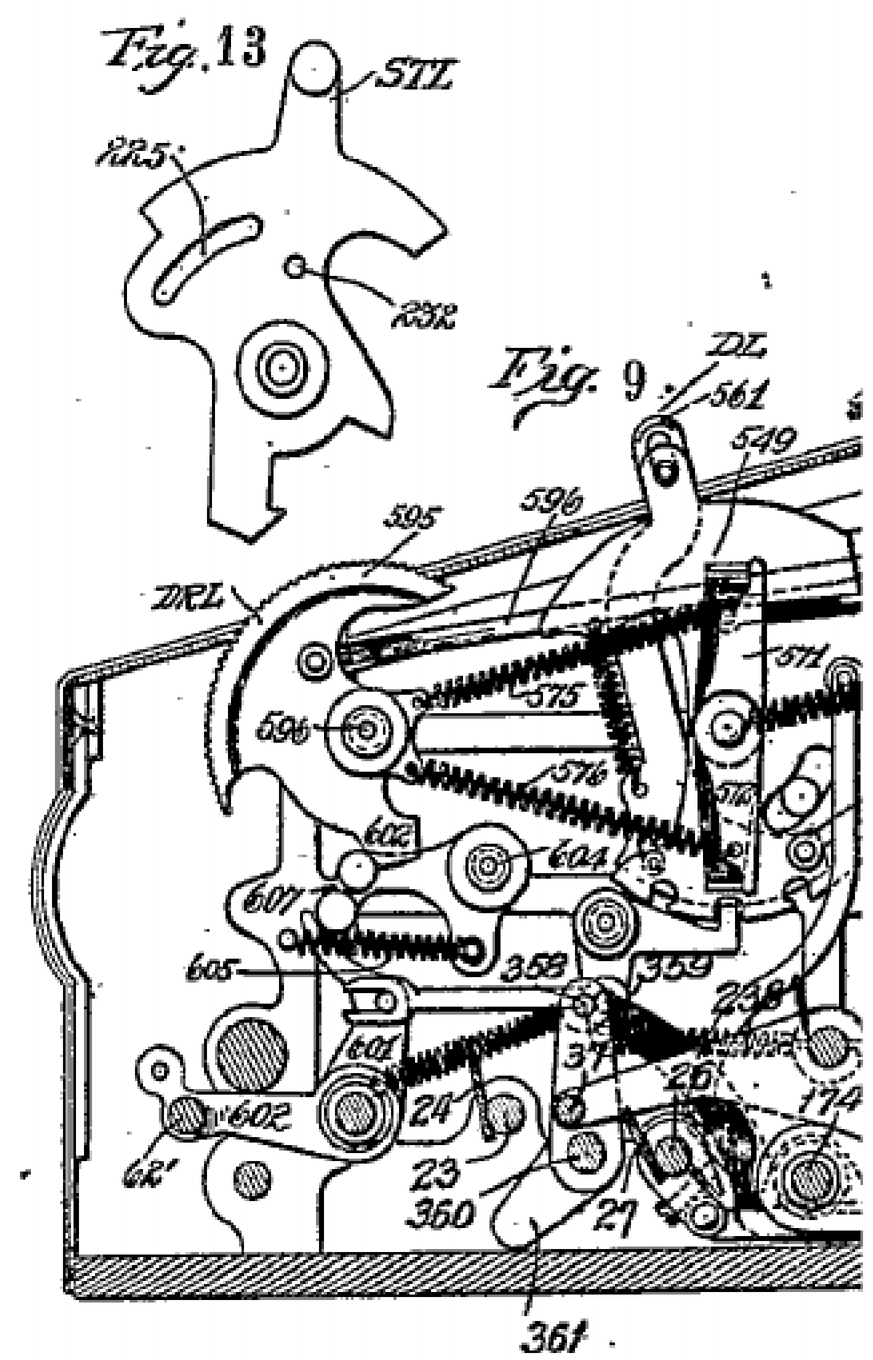


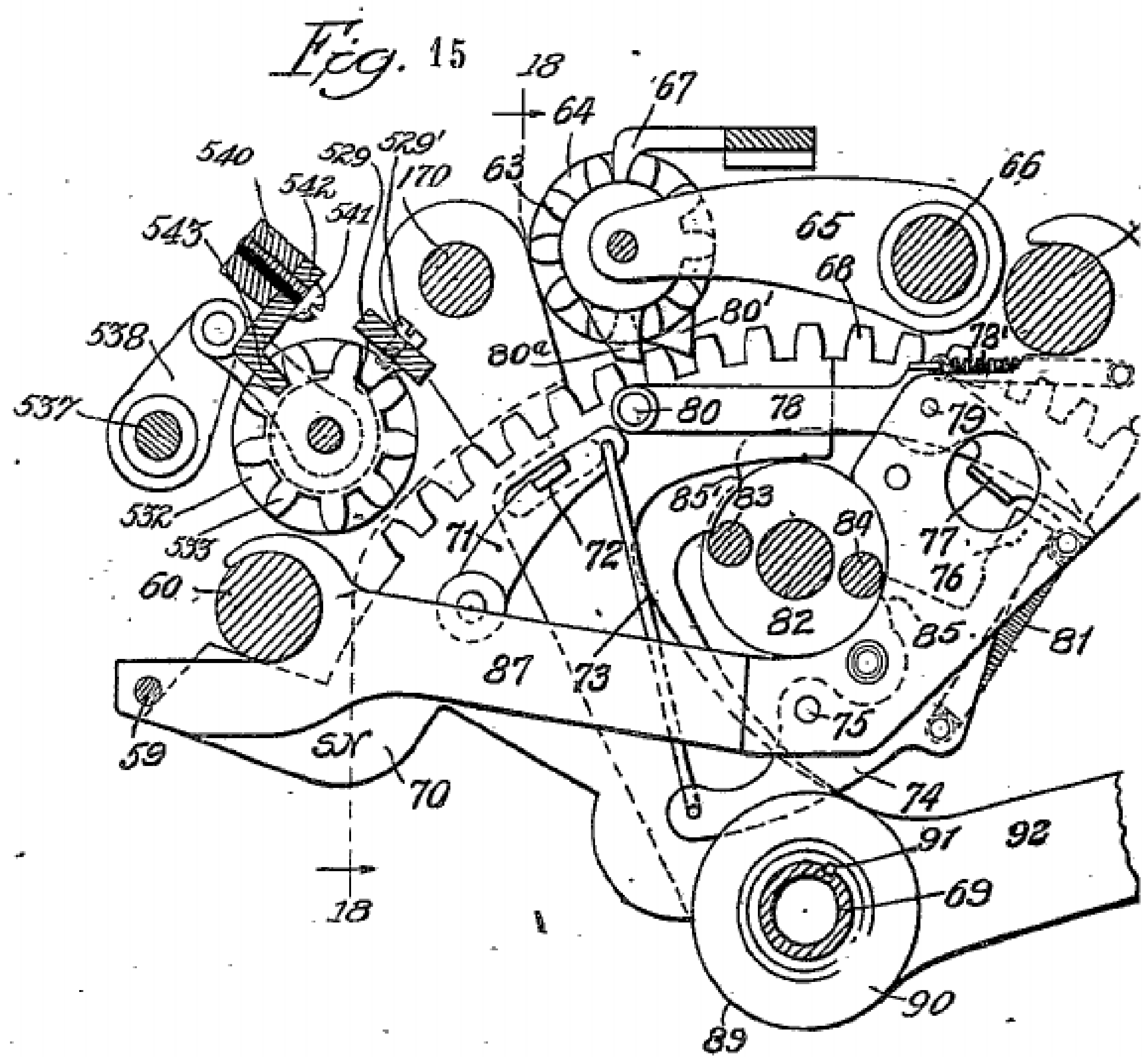
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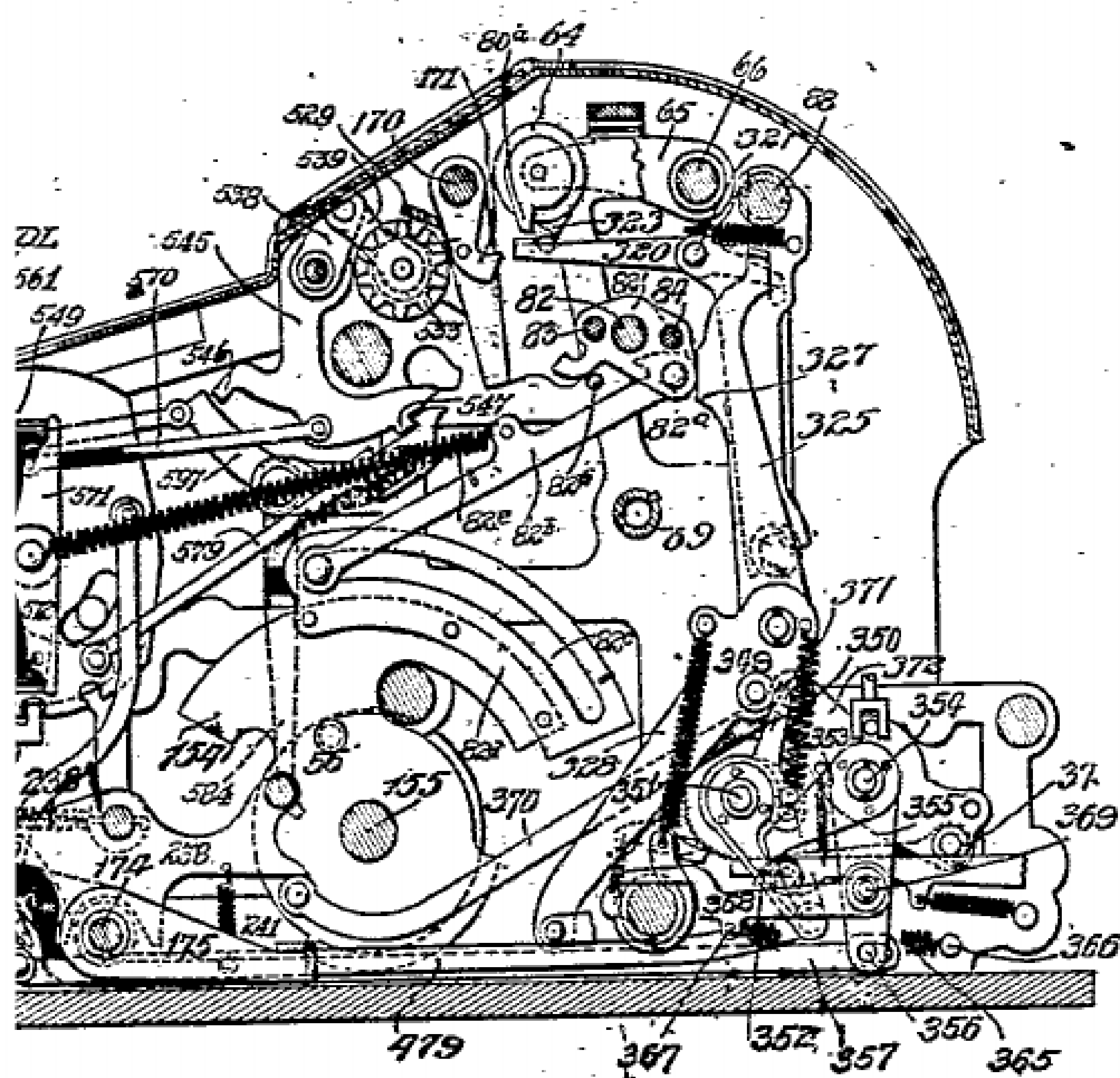

Fig. 13
Fig. 9

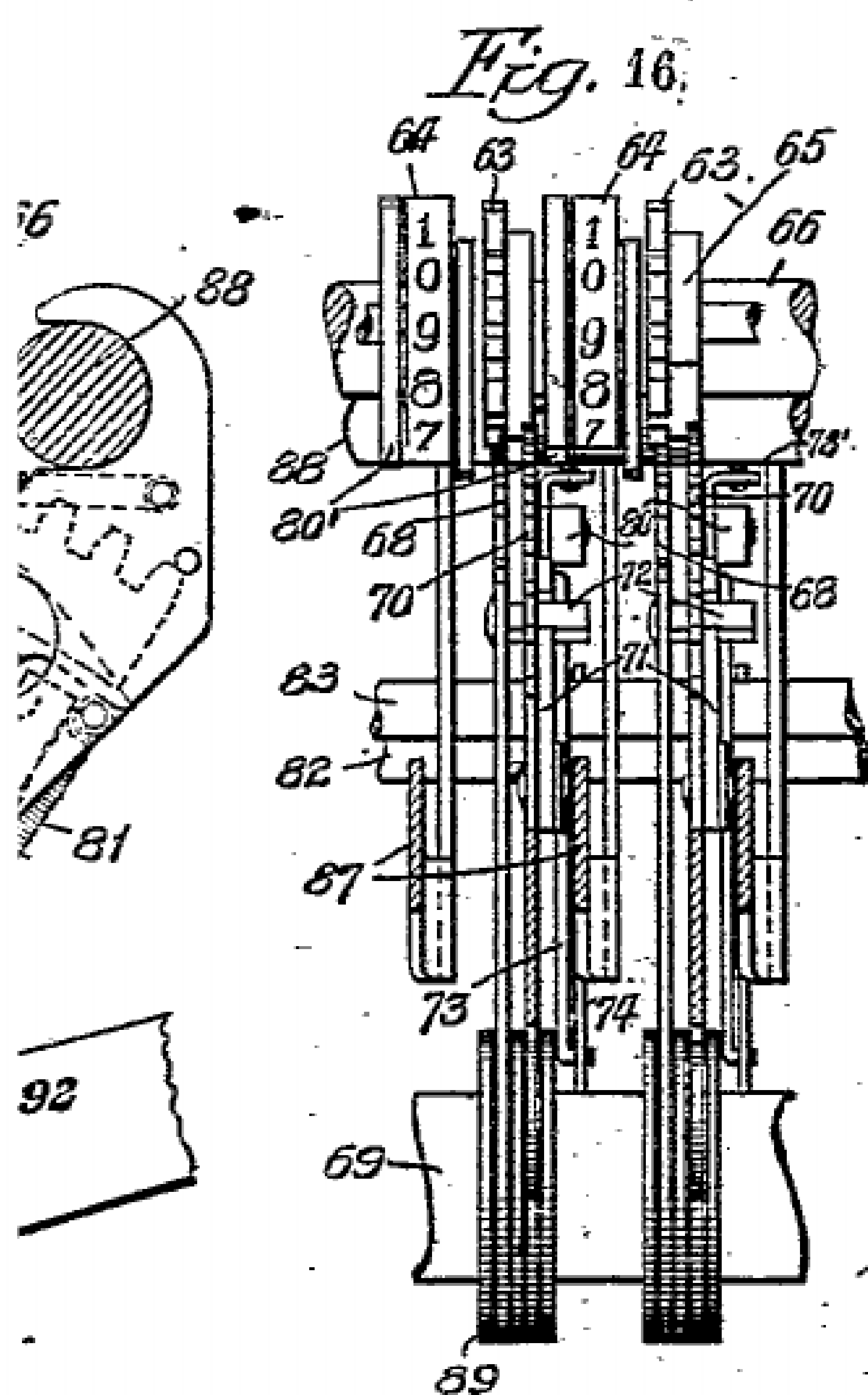

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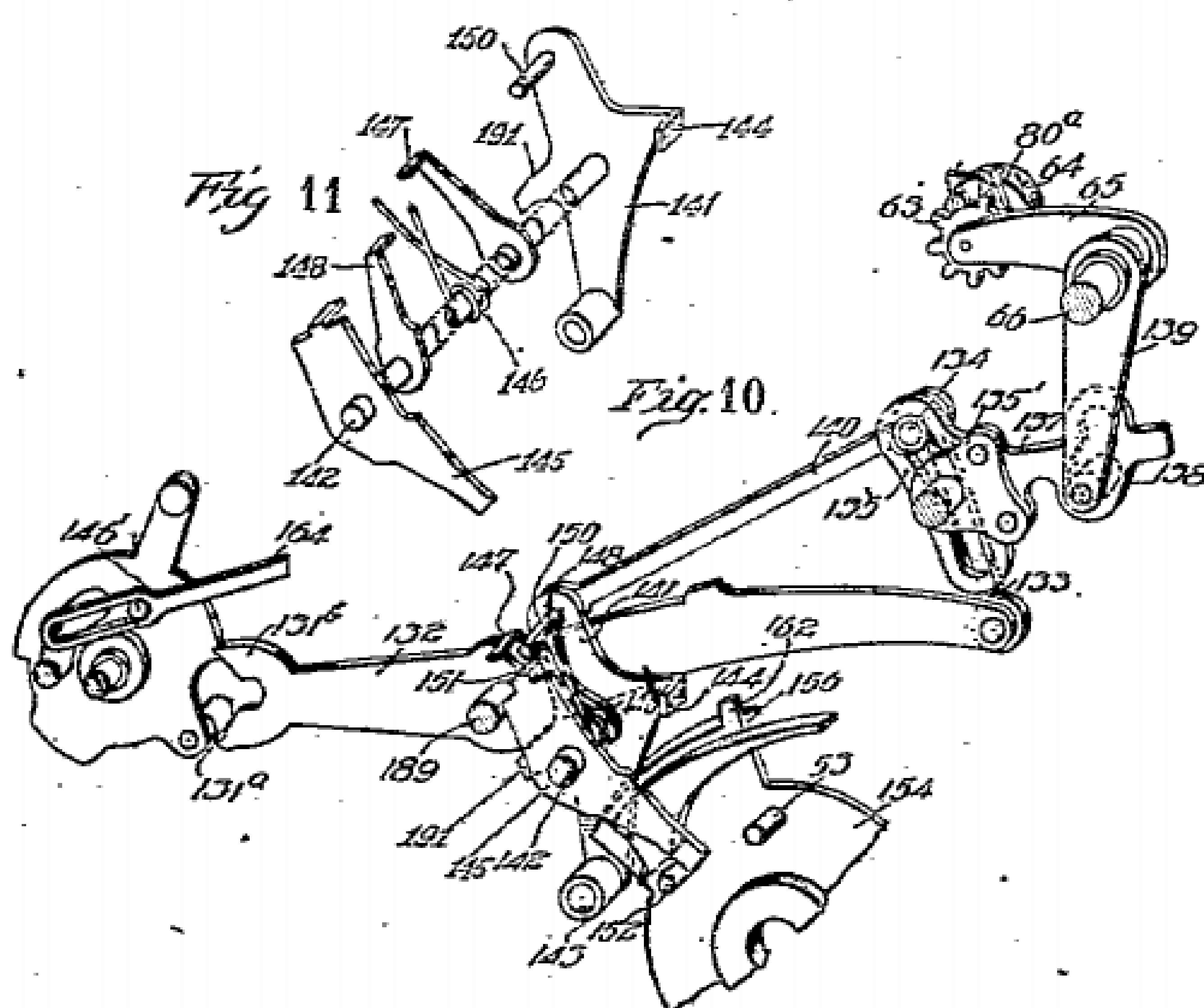

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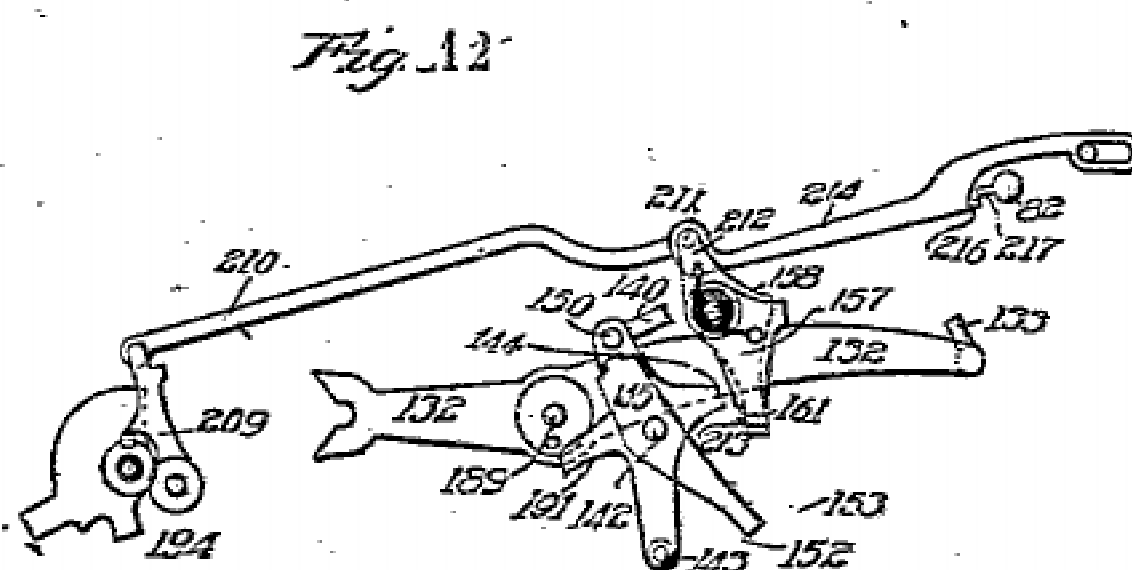

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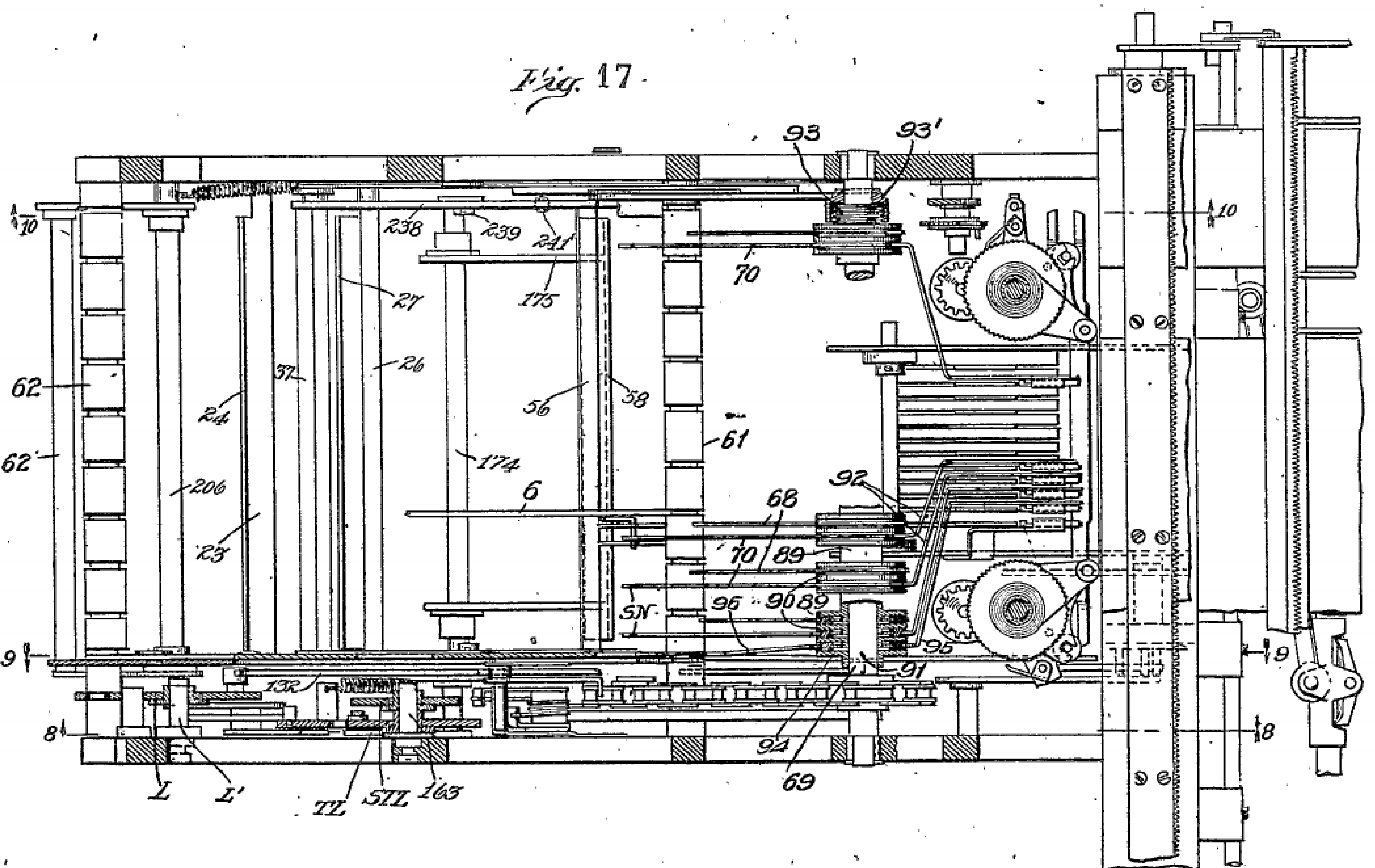

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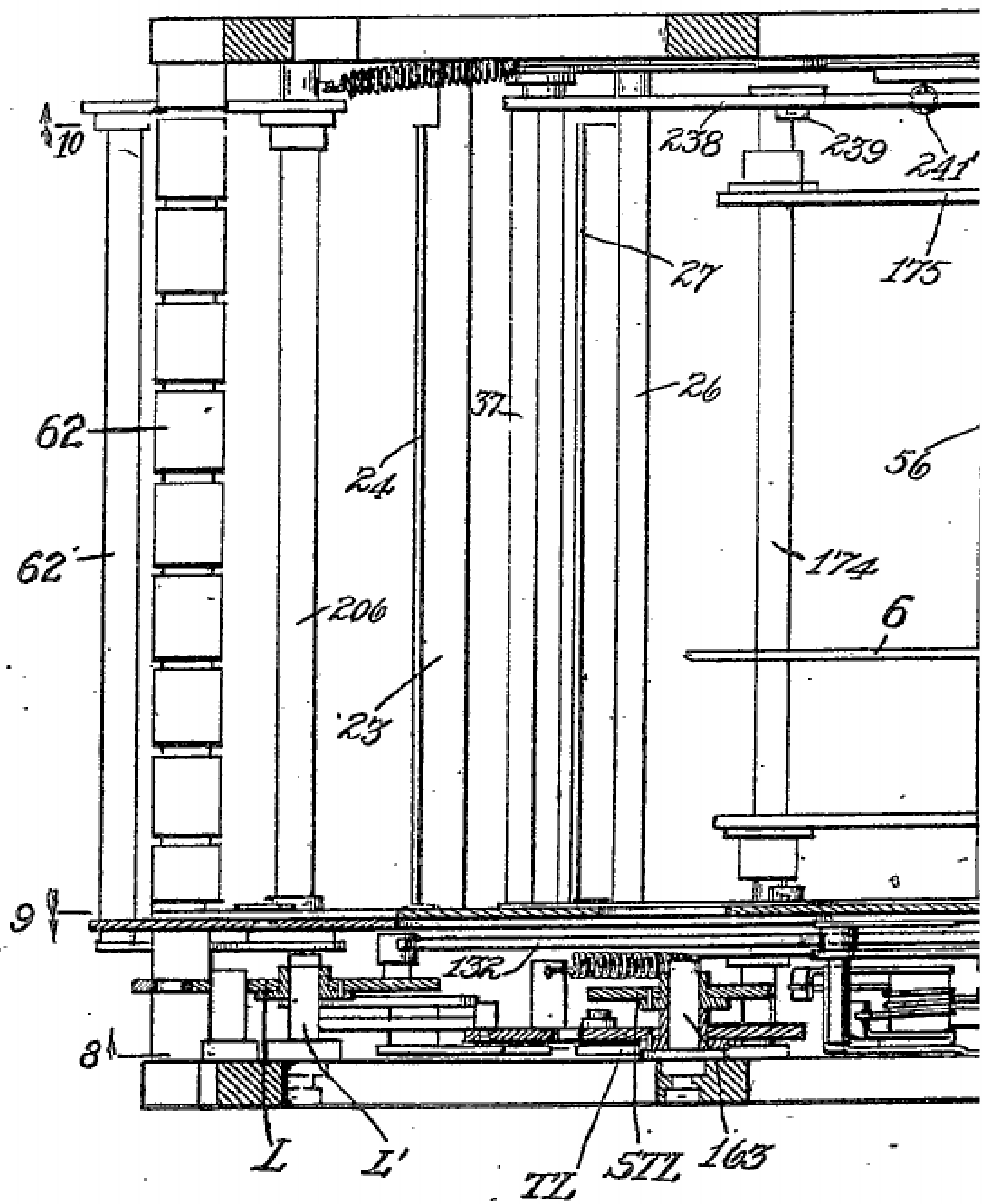



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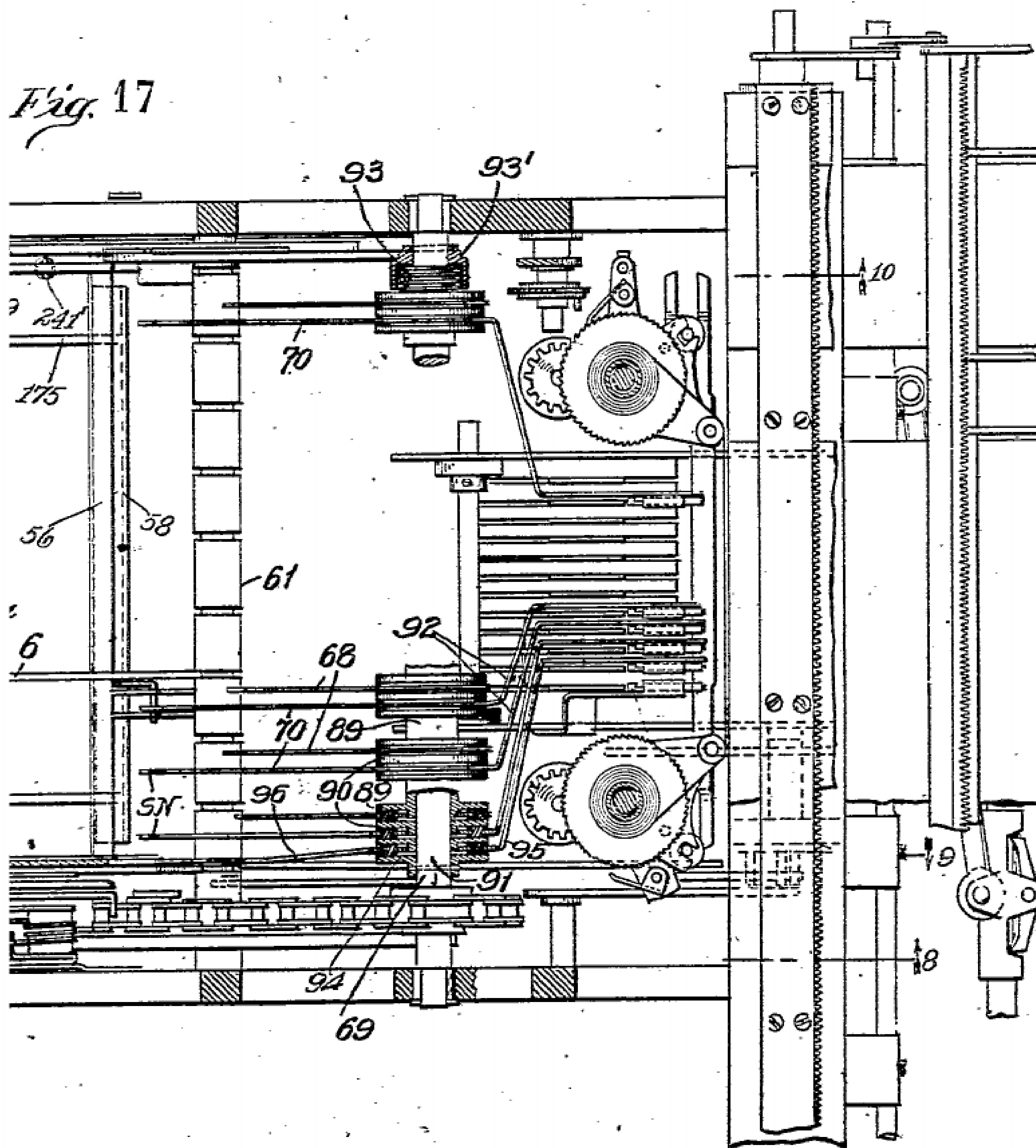

Fig 11
Fig. 10.


Fig. 12


Fig. 17
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Fig. 17
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NEXT ITEM

I CLAIM:-

1. In a calculating machine, a casing, a plurality of transverse shafts mounted therein, a series of partitions removably supported on and slidably engaging said shafts, releasable means for retaining said sections in position on said shafts and adapted to be lifted away therefrom, key mechanism carried by each partition and removable therewith, and a section secured to each partition, said sections fitting together removably and forming a portion of the casing top or cover.

2. In a calculating machine, a casing, a plurality of transverse shafts mounted therein, a series of partitions removably supported on and slidably engaging said shafts, releasable means for retaining said sections in position on said shafts and adapted to be lifted away therefrom, key mechanism carried by each partition and removable therewith.

3. In a computing machine, a frame, a plurality of key-board sections removably mounted in said frame and accumulator mechanism including transfer devices operable from the key-board sections, means for preventing the transfer action of the transfer device, whereby the cooperating key-board section may be withdrawn without affecting the operation of the machine.

4. In a calculating machine, a depressible key stem carrying a lug, a swinging stop for holding said key depressed, a stop wire, and a swinging connection between said stop wire and said key stop to permit movement of said wire while said key is depressed.

5. In a calculating machine, a swinging stop nose, stop wires therefor, keys for controlling said stop wires and yielding connections between said stop wires and said keys permitting said stop nose to swing backward over said stop wires, brushing them aside, while their respective keys are still in depressed condition.

6. In a calculating machine, a stop wire, a key, a swinging stop nose, connections between the key and the stop wire whereby the wire is yieldingly held in the path of the stop nose after the key has been depressed.

7. In a calculating machine, a stop device, a stop nose, one of said elements having a beveled face whereby the two may relatively pass each other in one direction, and key controlled means for resiliently forcing said stop device into the path of said stop nose when the key is depressed.

8. In a calculating machine, depressible key stems, a swinging stop for engagement with each key stem to hold its key in depressed position, a stop wire and a pivoted member swinging with said key stop to thrust said wire into stopping position, but movable independently of said key stop to allow return movement of said stop wire even though the key remains depressed.

9. In a calculating machine, a plurality of keys, a plurality of stop wires, swinging elements connected to the stop wires and adapted to thrust the latter into stopping position, stops for retaining depressed keys mounted behind the swinging elements whereby movement of the stops in one direction will positively shift the swinging elements, said elements, however, being movable independently of the stops.

10. In apparatus of the class described, a plurality of keys, a plurality of stop wires, swinging elements connected to the stop wires, swinging stops associated with said elements and adapted to retain the keys in depressed position, said swinging elements being disconnected from the swinging stops whereby the stop wire may be moved when a key is in depressed position.

11. In apparatus of the class described, accumulator mechanism, swinging stop noses for operating said accumulator mechanism, a series of keys arranged in rows, a series of stop wires, connections between said wires and keys whereby the wires may be individually advanced through the keys into the path

of the stop noses, all so constructed and arranged that the wires will only stop the noses when the latter are moving in one direction.

12. In a calculating machine, a depressible key stem carrying a lug and swinging stirrup for engagement with said lug, a saddle member capable of swinging with said stirrup, a stop wire pivoted to said saddle member, and a spring urging said stirrup into stopping position, said saddle member being capable of movement independently of said stirrup to re-direct the stop wire even though the key stem be still held by its stirrup stop.

13. In a calculating machine, the combination of depressible key stems, a plurality of sets of stop wires actuated thereby, a swinging stop nose for each set of wires, connection between said stop wires and their respective keys, permitting return movement of the wires even though the keys be down, and a member movable to positively return the stop wires and release depressed keys.

14. In a calculating machine, a key-board section having depressible key stems, stop mechanism for each key stem to hold its key in depressed position, a stop wire controlled through said stop mechanism and means effective for disconnecting each stop wire from its controlling key for withdrawing the stop wires from stopping position independent of the position of their respective key stems.

15. In a calculating machine, depressible key stems, stop wires actuated thereby, connecting means between said wires and said stems, and a sliding plate for swinging said connecting means to positively return the stop wire and to release depressed keys.

16. In a calculating machine, depressible key stems, stop wires actuated thereby, connecting means between said wires and said stems, and means for swinging said connecting means to positively return the stop wire and to release depressed keys.

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17. In a calculating machine, depressible key stems in sections, stop wires actuated thereby, connecting means between said wires and said stems, and a sliding plate for each section for swinging said connecting means to forcibly return the stop wire and to release depressed keys, and a correction key for each sliding plate to release all the depressed keys of any one section, independently of the other sections.

18. In apparatus of the class described, a key-board including a plurality of rows of keys, accumulator sections, stop noses, stop wires normally automatically movable into stopping position upon the depression of keys, manually operable means for disconnecting the stop wires and keys and maintaining the stop wires in inoperative position , means for rendering said last named means inoperative during a portion of every turnover of the machine.

19. In a calculating machine, the combination of depressible key stems, accumulator mechanism, swinging stop noses, adapted to be controlled either through the key stems or through the accumulator mechanism, stop wires for the stop noses, connections between the key stems and the stop wires, a correction key for effectively disconnecting the stop wires from the key stems and returning the latter independently of the positions of the key stems, means for temporarily rendering the connection key inoperative during the normal operation of the machine.

20. In a calculating machine, accumulator sections, stop noses associated therewith, a set of keys, means whereby the depression of individual keys determines the position of the stop noses, means prevailing over said last named means whereby the position of the stop noses is rendered independent of the depressions of individual keys, means for rendering inoperative the last named means during a portion of each cycle in the operation of the machine.

21. In a calculating machine, the combination of an accumulator, stop noses controlling the movements of the accumulator, and stop wires, depressible key stems whereby said stop wires may be put in stopping position, the connections between the key stems and the stop wires being such that the stop wires will not interfere with the return movement of the stop noses even though they lie in the return path of the stop noses and must be moved thereby.

22. In a device of the class described, a lever carrying type at one end, and a stop nose at the other end, a rock shaft serving as a support for said lever, a separate rack arm also supported by said rock shaft and a friction connection between said rock shaft and said lever and between said rock shaft and said rack arm.

23. In a device of the class described, the combination of a lever carrying type at one end and a stop nose at the other, a swinging support for said lever, friction means for yieldingly holding the type bearing lever to the support, a separate swinging rack arm carried by said support and friction means for yieldingly holding the rack arm to the support, and means for swinging the support to swing said lever and its type and to swing said rack arm.

24. In a calculating machine, a shaft, means for rocking the shaft, a collar frictionally mounted on the shaft and having a stop nose and a type carrier thereon, a separate rack arm frictionally mounted on the shaft, a stationary stopping member for limiting the travel of the stop nose in one direction, selectively operable devices for limiting the travel of the stop nose in the other direction at variable points.

25. In apparatus of the class described, a rocking member, a collar frictionally mounted on the rocking member and carrying a stop nose and a type head, a rack having a slip connection with the collar, manipulative means for variously limiting the forward travel of the stop nose, releasable means for

locking the rack to the stop nose whereby when said last named means are released the rack may travel on after the stop nose has been stopped.

26. In a calculating machine, a rock shaft, a member frictionally mounted upon the rock shaft and carrying a stop nose and a type carrier, a segmental rack frictionally mounted at its center upon the rock shaft, an accumulator element adapted to be operated by the rack, manipulative means for selectively limiting the forward travel of one of the frictionally mounted members, locking mechanism whereby the stop nose and the rack are locked for movement together, including means whereby, when unlocked, one of said members may travel a distance corresponding to the space of one rack tooth with respect to the other, stationary means for limiting the rearward travel of one of said members whereby when the locking mechanism is released one of said members will travel the space of one rack tooth beyond the travel of the other.

27. In a calculating machine, a rocking shaft, a plurality of members frictionally mounted on said rocking shaft and each carrying a stop nose and a type head, segmental racks frictionally mounted on said shaft and having a slip connection with each of said members, accumulator mechanism operable by said racks and including tripping devices, selectively operative mechanisms associated with each member and rack, and adapted to limit the forward travel of one thereof, stationary means adapted to limit the rearward travel of one thereof, a latch and means to permit the racks and members to shift a distance of one rack tooth relatively to each other when the latch is tripped.

28. In a calculating machine, a rockingshaft , a member comprising a stop nose, frictionally associated with said shaft, another member frictionally associated with the shaft and with the stop nose for operating an accumulator section, a latch

device for locking said two members together as regards angular movement about the shaft, means for limiting the rearward movement of one of said members whereby when the latch is tripped one of said members will have traveled beyond the other at the end of the rearward rocking movement of the shaft.

29. In a calculating machine, a rock shaft, a member comprising a stop nose frictionally associated with said shaft, another member frictionally associated with the shaft and with the stop nose for operating an accumulator section, a latch device for locking said two members together as regards angular movement about the shaft, means for limiting movement of one of said members whereby when the latch is tripped one of said members will have traveled beyond the other at the end of the rearward rocking movement of the shaft, and means for thereafter realining said members and relatching the latch device.

30. In a calculating machine, a rock shaft, means for causing the rock shaft to make a partial rotation and return, stop noses and racks frictionally mounted on said rock shaft, means for limiting the swing of the stop noses in either direction, latch devices for causing the stop noses and racks to move together, tripping devices for releasing the latches whereby when the latch is released the racks will move beyond the stop noses at the end of the return swing of the rock shaft, means for thereafter realining said racks and stop noses and relatching the latch devices.

31. In a device of the class described, a type bearing lever, a friction support for said lever, a swinging rack carried by said support and movable with respect to said lever and means for operating the friction support to swing said rack and said lever, and means for retarding the movement of the lever to shift its position with respect to said rack.

32. In a device of the class described, the combination of a type bearing lever having a stop nose, a support for said

lever, friction means yieldingly holding said lever to the support , a rack carried by said support and capable of swinging with respect to said lever, means for operating the supporting means and means for retarding the movement of the type bearing lever, while permitting a limited further movement of said rack.

33. In a device of the class described, the combination of a rock shaft, spools and disks placed alternately on said shaft and swinging therewith, means for yieldingly holding said spools and disks toward each other and a type bearing lever carried by said rock shaft between a spool and a disk and frictionally driven thereby when the rock shaft turns, whereby the stopping of said lever will not stop the shaft and soft metal pads on said lever and frictionally engaged between said spool and disk.

34. In a device of the class described, the combination of a rock shaft, friction spools and disks fixed to swing with said shaft and slidable thereon, there being at least one disk between each pair of spools, said spools and disks being held toward one another by spring pressure and type bearing arms, each of which is frictionally engaged by the adjacent sides of a spool and disk, means for swinging the rock shaft to swing the type bearing arms, and manually operated stops for checking the movement of said arms.

35. In a device of the class described, the combination of a rock shaft, means for swinging it, a pair of spools, and a collar mounted upon said shaft and swinging therewith, a shoulder on said collar and a type bearing arm mounted thereon and held between said collar and one of said spools and a swinging rack arm frictionally held between the other side of the collar and the other spool.

36. In a device of the class described, the combination

of a rock shaft, and type bearing levers and rack arms mounted thereon and capable of independent movement, latching means for connecting each rack bar with one of said levers for simultaneous operation, a series of spools and disks mounted on said rock shaft to turn therewith and free to slide thereon, said rack arms and said levers being positioned in pairs in frictional engagement with the opposite sides of the disks.

37. In a machine of the class described, calculating mechanism arranged in sections and including transfer mechanism, shafts, each of said sections including a plate having an element of the transfer mechanism mounted thereon and provided with open ended slots, said slots being slidable onto and off of said shafts in a direction transverse to the length of said shafts, whereby said plates and attached transfer parts may be selectively removed or interchanged.

38. In a machine of the class described, an accumulator comprising a plurality of sections, each removable from the machine as a unit without disturbing the other sections, numeral wheels and a cam adjacent to each numeral wheel and cooperating with one of said sections to unlatch the same when a transfer is to be made from one section to the next.

39. In a calculating machine, an accumulator section comprising a plate having recesses therein adapted to removably fit upon appropriate rods in the machine, staffs mounted in said plate, a cover plate removably secured to said staffs, a trip lever pivotally mounted between said plates, a lever controlled by said trip lever, a link secured to said last named lever for operating a latch, all for the purpose described.

40. In apparatus of the class described, a plurality of accumulator pinions, a plurality of racks for operating said pinions, stop noses associated with said racks, selective means for variously limiting the movement of said stop noses,

means for preventing relative movement between the racks and the stop noses, transfer mechanism for releasing said preventive means whereby the racks and stop noses may have a relative movement, said last named mechanism being controlled in accordance with the setting of the accumulator pinions, means for repositioning the stop noses and racks and simultaneously re-setting the movement preventing devices.

41. In a machine of the class described, a swinging rock shaft, stop nose arms frictionally driven thereby, stop wires positioned to determine the swing of the various stop noses, a swinging rack carried by said rock shaft, accumulator wheels adapted to be brought into mesh with their respective racks, sectionalized transfer mechanism actuated in accordance with the setting of the corresponding numeral wheels and connections from said transfer sections to their respective stop noses to permit slipping of the stop noses with respect to their racks in either direction when a transfer is to be made from one numeral wheel to the next.

42. In a machine of the class described having swinging stop noses, and stop wires for regulating the swing of those noses, the combination of numeral wheels, swinging racks with which those wheels may be thrown in mesh and transfer mechanism operative through the action of said numeral wheels to slip said racks with respect to their stop noses in either direction to transfer across the machine in either direction from one numeral wheel to the next.

43. In a machine of the class described, the combination of a rock shaft, type bearing levers frictionally driven by said rock shaft and each bearing a stop nose, swinging rack arms frictionally driven by said rock shaft, the latching means holding said rack arms to move with said stop noses, numeral wheels each provided with a cam and means interposed between each cam and the latching means to a stop nose for releasing the

swinging rack and allowing it to slip in either direction with respect to its stop nose by a distance equivalent to one tooth of the rack.

44. In a machine of the class described, a combination of a rock shaft, the swinging levers frictionally driven thereby each carrying printing means at one end and a stop nose at the other, a swinging rack carried by said rock shaft, accumulator wheels meshing with said racks and means for slipping a rack with respect to its stop nose when the corresponding accumulator wheel has made one complete revolution and must transfer across to the next adjacent wheel.

45. In a calculating machine having a swinging stop nose arm with a type bearing head at one end, the combination with spring pressed type mounted in each of said heads and a ribbon guard positioned at the side of each head and projecting beyond the inactive position of the type faces.

46. In a calculating machine, swinging racks, accumulator pinions adapted to mesh with said racks, a lever and mechanism associated therewith for snapping said pinions into mesh with said racks at the beginning of the forward stroke of the latter and out of mesh at the end of the forward stroke thereof, or vice versa, according to the setting of said lever, a control lever for said swinging lever adapted to assume two positions, connections between the control lever and the lever whereby, in which ever position the control lever may be, it may move substantially to the opposite position before disturbing the setting of the swinging lever and thereafter in its continued movement will quickly snap the swinging lever to the opposite position, and means for locking the machine during the shifting of the control lever.

47. In a calculating machine, swinging racks, numeral pinions, a swinging lever, spring devices and mechanisms associated with said lever for snapping said accumulator pinions

into mesh with the swinging racks at times controlled by the setting of said swinging lever, a shiftable control device for controlling the setting of the swinging lever, connections between the control devices and the lever whereby the control device may move from the position corresponding to either setting of the lever, substantially to a position corresponding to the other setting of the lever, without disturbing the lever, and means for locking the machine during the shift of the control lever.

48. In a machine of the class described, the combination of swinging racks, pinions for meshing with said racks, and a spring tension device for snapping said pinions into mesh with the racks and means for reversing said tension device subsequently to snap the pinions out of mesh with their racks.

49. In a machine of the class described, the combination of a main drive shaft, a plate swinging therewith, a tension device actuated by said plate, swinging racks, pinions for meshing with said racks and releasing mechanism associated with said tension device and cooperating with said swinging plate to shift the pinions with respect to their racks at the proper moment.

50. In a calculating machine, swinging racks, stop noses, stop wires, numeral pinions having stop devices thereon, totaling elements comprising means movable into position for engagement by said stop devices, means to snap the pinions into engagement with the racks at the beginning of the swing thereof, and means to withdraw the stop wires whereby the control of the racks is shifted from the stop noses to the stop devices and the racks are set to a position corresponding to the total while the machine is cleared.

51. In a machine of the class described, the combination of a shifting carriage, a platen carried thereon, printing mechanism cooperating with said platen, key-set mechanism for governing the action of the printing mechanism, an adding and subtracting lever, and power driven means for shifting

said carriage with respect to said printing mechanism when said adding and subtracting lever is shifted.

52. In a calculating machine having control means for changing from additions to subtractions, of a sliding carriage and power driven means for shifting said carriage automatically with the shifting of said control means.

53. In a calculating machine having a printing mechanism, and a key-board operatively connected to govern said mechanism, the combination of a sliding carriage, an accumulator, control mechanism for shifting said accumulator from additions to subtractions or vice versa, and means for positively shifting said carriage automatically when said control means is shifted.

54. An adding and subtracting machine having a sliding carriage, and power driven means for shifting said carriage automatically when said machine is changed from adding to subtracting.

55. In a calculating machine having a sliding carriage, the combination of a motor, clutch mechanism for connecting said motor with said carriage when the carriage is to be shifted and means for locking said clutch against operation when desired.

56. In a calculating machine having a sliding carriage, the combination of a continuously operating motor, a ratchet actuated thereby, a crank, clutch mechanism for connecting said crank to turn with said ratchet and connections between said crank and said carriage whereby said carriage may be shifted, said crank starting from dead center and stopping at dead center with respect to said connections.

57. In a calculating machine having printing mechanism and manipulative devices for governing said mechanism, the combination of an accumulator adapted to add or subtract, a carriage control mechanism for automatically positively shifting said carriage at the change from the adding to the subtracting operation of the accumulator or vice versa, and means for render-

ing said shifting mechanism inoperative.

58. In a calculating mechanism adapted to add or subtract, printing devices including a shiftable carriage, means for shifting said carriage at each change from addition to subtraction or vice versa, whereby amounts added and subtracted are printed in different columns.

59. In a calculating machine having control mechanism for shifting from additions to subtractions, the combination of a sliding carriage and continuously operating motor, a clutch mechanism responsive to the condition of the machine whether set for additions or subtractions and operative to connect said motor with said sliding carriage to shift the carriage so that added items may be printed in one column and subtracted items in another column.

60. In a calculating machine having a printing mechanism, an accumulator, and means for printing a total, a platen, means for shifting paper over said platen at each stroke of the printing mechanism, and means for giving a double shift to the paper when a total is to be printed.

61. In a calculating machine having an accumulator, a printing mechanism and a total lever for setting the printing mechanism to print the total in the accumulator, of a platen shifting means and means for giving the platen a double shift when theprinting mechanism is to print a total.

62. In a calculating machine, a sliding platen carriage, power driven means for shifting said carriage and means for interrupting said driving connection and locking said carriage against sliding movement when desired.

63. In a calculating machine having an accumulator, printing means and key-set mechanism for controlling the accumulator, means for printing a total as indicated by the accumulator and means for locking the machine against printing when the accumulator is in an over-draft condition.

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64. In a machine of the class described having a printing mechanism, an accumulator and manually controlled means for governing the accumulator, of a total lever, and means for locking said total lever when the accumulator is in an over-draft condition.

65. In a machine of the class described having a plurality of number wheels and means for transferring the rotation of one wheel to an adjacent wheel, of a cam carried by the last wheel of the series, printing mechanism operative to produce a permanent record of the setting of the accumulator while adding or subtracting normally, and means actuated by said cam for printing on said record a special over-draft character when subtracted items have run the numeral wheels beyond their lower limit and thereby have swung the last wheel of the series backward from its zero to its nine position.

66. In a calculating mechanism, key-set device, stop nose arms controllable therefrom and having rackteeth , duplicator pinions having stops, other stops adjacent thereto, means to cause the duplicator pinions to mesh with the stop nose rack teeth during one movement of the latter, whereby the pinion stops are moved away from the other stops, means to cause the duplicator pinions to mesh with the stop nose rack teeth during another movement of the latter whereby said stops are brought together to selectively limit the movement of the stop nose arms in accord with the setting of the duplicator stops.

67. In a calculating machine including swinging actuating devices, a duplicator mechanism comprising duplicator pinions adapted to be swung into or out of mesh with said actuating devices, means for positively holding the duplicator pinions selectively in or out of mesh, means for simultaneously imparting a tension to said duplicator mechanism to shift it in the opposite direction and means for tripping said positively engaging means at the end of the first half cycle of the machine operation, whereby said pinions are snapped out of or into mesh

as the case may be.

68. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are each detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, and means for rotating the calculating wheels in opposite directions.

69. In a calculating machine, a calculating mechanism, a series of calculating sections in the calculating mechanism, each of which is detachably mounted in the machine, and the parts of which are each detachably connected with each other, a calculating wheel in each calculating section, designed to be rotated in opposite directions for adding and subtracting, a calculating rack for each of the calculating wheels, and means for driving the racks for rotating the calculating wheels in either direction, and means to cause said racks and wheels to engage and disengage at different points in the operative cycle of the machine.

70. In a calculating machine, a spring operated totalizing mechanism, an adding and a subtracting lever for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby the parts are returned to their normal position after the completion of the addition or subtraction, and locking means for holding the parts of the device in their proper positions while the calculating mechanisms are completing their operations and later releases same to allow spring to act.

71. In a calculating machine, an automatic calculating mechanism, means for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby the parts are returned to their normal position after the complet-

ion of the addition or subtraction, a printing mechanism operatively connected with the calculating mechanism for automatically printing the numbers which are added or subtracted, a carriage in the printing mechanism, and means for automatically shifting the carriage when the subtracting lever is operated to list the subtracted numbers in a column separate from the column used in listing the added numbers.

72. In a calculating machine, a key controlled automatic calculating mechanism, an adding and a subtracting lever for throwing the calculating mechanism into and out of operation for adding or subtracting, whereby parts are returned to their normal position after the completion of the addition or subtraction, a printing mechanism operatively connected with the calculating mechanism for automatically printing the numbers which are added or subtracted, a carriage in the printing mechanism, and means for automatically shifting the carriage when the subtracting lever is operated to list the subtracted numbers in a column separate from the column used in listing the added numbers.

73. In a calculating machine, a series of numeral wheels, and a carry-over mechanism associated with said numeral wheels, said mechanism consisting of a plurality of independently removable sections, there being a section for each but the highest order numeral wheel.

74. In a calculating machine, a plurality of calculating sections, key-controlled mechanism for operating said calculating sections to perform addition or subtraction, a plurality of transverse shafts mounted in said machine, each of said sections slidably engaging said shafts, and releasable means for retaining said sections in position on said shafts.

75. In a calculating machine, a combination of a rock shaft, a plurality of friction members rigidly mounted thereon, each member consisting of a sleeve which terminates at either

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end in a disk provided with an axial flange, the flanges of adjacent disks extending toward each other to present opposing friction surfaces, a collar held between each pair of opposing flanges, a type arm frictionally held between one face of said collar and the adjacent disk, and a rack arm frictionally held between the other face of said collar and its adjacent disk, calculating mechanism adapted to be actuated by said arms, and means for yieldably forcing said friction members together.

76. In a calculating machine, the combination of a rock shaft, a plurality of friction members rigidly mounted thereon, each member consisting of a sleeve which terminates at either end in a disk provided with an axial flange, the flanges of adjacent disks extending toward each other to present opposing friction surfaces, an intermediate disk mounted on said shaft between each pair of opposing flanges and provided with a peripheral frictional flange in alinement with the flanges on either side thereof, an actuating arm held frictionally between each intermediate disk and one of the adjacent end disks, a controlling arm held frictionally between each intermediate disk and the other adjacent end disk for controlling the operation of the associated actuating arm, means for yieldably forcing said friction members together, and calculating mechanism adapted to be operated by said actuating arms.

77. In a calculating machine, the combination of a rock shaft, a pair of end disks mounted thereon, an intermediate disk mounted on said shaft between said end disks, said disks being provided with opposing frictional flanges, a type lever held frictionally between the intermediate disk and one of the end disks, a rack arm held frictionally between the intermediate disk and the other end disk, and means for yieldably forcing said disks together.

78. In a calculating machine, the combination of a shaft, a pair of friction members mounted thereon, an arm held

frictionally between said members, said arm having a soft metal pad on each side thereof, said pads frictionally engaging the adjacent faces of said friction members respectively, a calculating device adapted to be operated by said arm, and means for yieldably forcing said members together.

79. In a calculating machine, the combination of a shaft, an arm, frictional means for operatively supporting said arm on said shaft, said frictional means including restricted annular contact surfaces between which said arm is frictionally held, said arm having a soft metal pad on each side thereof to frictionally engage said surfaces, and a calculating device adapted to be operated by said arm.

80. In a calculating machine, the combination of a series of numeral wheels, a toothed sector associated with each numeral wheel for operating the same a predetermined amount, a key-controlled arm associated with said sector for controlling the operation thereof, a pin and slot connection between each sector and its arm to permit a one space movement of the sector in either direction independently of the associated arm, means for normally locking each sector and its arm together for simultaneous operation, connections between the numeral wheels and said locking means, whereby a lower-order wheel on passing through zero automatically releases the sector of a higher-order wheel to carry one unit into the higher-order wheel, and means for locking any desired sector against release to prevent carrying through that sector.

81. In a calculating machine, the combination of a rock shaft, a pair of friction disks rigidly mounted thereon, said disks being provided with peripheral flanges, an arm held frictionally between said flanges, an indicating member adapted to be actuated by said arm, and means for yieldably forcing said disks together.

82. In a calculating machine, the combination of a

calculating wheels, a key-controlled rack associated with each wheel for actuating the same, means for operating said racks to clear the numeral wheels, a key-controlled stop-arm associated with each numeral wheel, and a lug provided for each numeral wheel to engage said arm when the numeral wheel reaches zero position.

83. In a calculating machine, the combination of calulating wheels adapted to receive entries, supplemental mechanism arranged to be operated in accordance with the indication of said calculating wheels at any time, a sectional keyboard, means for locking said sections in position, and means controlled by said mechanism for releasing said locking means.

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NEXT ITEM

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IMPROVEMENTS IN CALCULATING MACHINES.

This invention relates to calculating machines.

The more salient features of the present invention are the following:

1. A key-board built up out of sections, any one of which may be removed easily without disturbing the others and without removal of the mechanism which supports the sections in position, and all of which sections may be made up of a standard size and as interchangeable elements and may be assembled in any one machine or transferred from one machine to another as desired. This results in economy of manufacture. convenience in assembling, equalizing wear on parts, and permits shifting one section to take the place of another in the same machine.

2. A rock shaft extending through the machine and carrying type-bearing arms frictionally supported on or provided with a slip joint connection with this rock shaft so that they will swing with it as the rock shaft turns, but may be stopped at predetermined points in their travel to correspond with the set-up on the keyboard.

3. A simplified arrangement of calculating wheels, and mechanism regulated in movement by the set-up of the keyboard to rotate these wheels, either forward or back as the case may be, to add or subtract items set up on the keyboard, the rotation of these wheels being governed by improved mechanism carried by the rock shaft and having a novel arrangement of parts for "carrying over" or transferring from one wheel to the next, as the total within the machine increases or decreases in size in accordance with the items for subtraction or addition, set up on the keyboard. The transfer mechanism is sectionalized and offers many advantages for commercial manufacture.

4. A printing mechanism having removable type heads or type carriers and having positive, double acting hammers and novel means for working and controlling the hammers, this printing mechanism having novel means for printing explanatory characters after the numerals printed on the paper, and thus representing something other than numbers to be added or subtracted, as for instance, invoice numbers or car numbers. The complete hammer section of the printing mechanism is so arranged with respect to the other elements of the machine that it can be quickly removed as a unit for inspection or repair.

5. Improved elements associated with the calculating wheels, whereby a total which has been recorded by the printing mechanism may either be retained in the calculating wheels or cleared therefrom as desired.

6. Mechanism of novel form for taking a number from the calculating mechanism and storing it for any length of time, but in such a way that subsequently it can be entered as an item into the calculating wheels without interfering with the other and more usual functions of the machine. This feature may be of use for duplicating a previous combination of figures entered on the numeral wheels.

7. An improved carriage mechanism mounted at the rear of the machine and easily detachable as a unit, this carriage mechanism having improved ribbon shifting means, improved platen shifting means and being connected up for control from the front of the machine so that it may be shifted longitudinally to print in either of two or more columns, as desired, this sliding or shifting carriage being power driven and positive in its action in either direction.

8. A locking mechanism to prevent the taking of a total when the machine has been operated below its normal (as in the case of overdraft) or is operating nearly up to its full capacity.

This prevents the machine from giving an erroneous total where the calculations have overrun the machine in either direction.

9. Improved driving means whereby an electric motor or its equivalent may be thrown into driving relation with the machine at the will of the operator and may be used not only to swing the rock shaft with its load of type-bearing levers and associated elements for actuating the calculating wheels, but also serves to shift the platen in either direction in case of two column printing. The clutch mechanism whereby driving connection is established or interrupted between the motor and the calculator is of novel construction and particularly designed to give an easy start for the motor and a cushioned stop for the shifting carriage.

10. A time limit device operating on the motor, to allow continued operation of the motor for a predetermined time after the operator leaves the machine, so that while the motor will be shut down automatically in case it is no longer needed, nevertheless the shutdown will not occur so quickly as to be of inconvenience to an operator who might leave the machine for a moment.

Other features and advantages are referred to hereinafter.

In the accompanying drawings illustrating a preferred embodiment of the invention:

Fig. 1 is a plan of the machine, a portion of the supporting platform being broken away at the front.

Fig. 2 is a transverse section through the keyboard and accumulating mechanism showing the hammer section in side elevation and omitting most of the platen, carriage and ribbon shift.

Fig. 3 shows a keyboard section on a larger scale, some of the parts being omitted.

Fig. 4 is a detail of the swinging stirrup and saddle which establish connection between each key-stem and its stop-wire.

Fig. 5 is a transverse section through one of the key-supporting plates.

Fig. 6 is a perspective illustration of the mechanism to control the zero stop-wire.

Fig. 7 is a horizontal section through Fig. 3 just above the sliding plate 20.

Fig. 8 is a longitudinal section just inside the right hand side plate.

Fig. 9 is a view looking in the opposite direction, the section being taken just inside of the control mechanism and between that mechanism and the first keyboard section.

Fig. 10 shows the controlling elements positioned at the left hand side of the machine.

Fig. 11 is a perspective view of the lever L and the reversing gear governed thereby, whereby the machine is shifted over from an adding machine to a subtracting machine.

Fig. 12 is a detail of the tension device appearing at the center of Fig. 11.

Fig. 13 is a side elevation of the eliminating lever including its connections running through to co-operate with some of the parts shown in Fig. 11 to hold the accumulator out of action while permitting the printing device to record an invoice number or the like.

Fig. 14 is a detail of the sub-total lever.

Fig. 15 shows the connections between the sub-total lever and the total lever.

Fig. 16 shows how the total lever is connected up with the sliding notched plate whereby the identifying character to be printed on the record at the side of the numbers is determined.

Fig. 17 is a side elevation of one section of the accumulator, illustrating the latching device which governs the slip between the stop-nose and its rack and thus controls the transferring or carrying over from one section to the next.

Fig. 18 is a front view of the structure shown in Fig. 17 partly in section and viewed in the direction indicated by the arrows Fig. 17.

Fig. 19 is a horizontal section showing in plan the main rock shaft and the swinging type arms, and also certain of the other parts.

Fig. 20 is a sectional detail of the slip joint whereby the stop noses and the swinging racks are swung from the main rock shaft.

Fig. 21 is an elevation of one of the side plates hammer section, and

Fig. 22 shows the other side of that section.

Fig. 23 is a transverse section illustrating the hammers and their relation to the printing heads and showing the means whereby the hammers are actuated or are locked against action.

Fig. 24 is a rear view of the hammer section, certain parts being broken away to show how one hammer may be made to carry across to the next when zeros are to be printed in after a numeral.

Fig. 25 illustrates the detachable printing head with its side plate forming a ribbon guard.

Fig. 26 is a detail of the type head showing the type and their respective springs in section.

Fig. 27 is a perspective view of one of the type showing the pin used for engagement with its controlling spring.

Fig. 28 is a plan partly in section of the ribbon carrier.

Figs. 29 and 30 are details of the cam mechanism utilized in reversing the direction in which the spools rotate to shift the ribbon.

Fig. 31 is a transverse section through the ribbon drums illustrating the swinging flaps used for starting the gears to shift the cam of Fig. 29 when the direction of a ribbon movement is to be altered.

Fig. 32 is a perspective view of one of the ribbon spools and its associated parts.

Fig. 33 is a vertical section through a ribbon spool showing in section the plate used as a dog to rotate that spool and also illustrating the toggle mechanism whereby the spool may be raised and lowered to shift the ribbon vertically and thus equalize the wear thereon.

Fig. 34 shows one of the ribbon spools in elevation and the platen carriage in section and is taken along line B-B of Fig. 37.

Fig. 35 is a similar section taken on line C-C of Fig. 37.

Fig. 36 is a detail of the bar positioned at the lower edge of the platen carriage through which connection is established to the motor so that the carriage may be shifted back and forth at the rear of the machine to print in two or more columns.

Fig. 37 is a plan of the detachable platen carriage showing the relative positions of the ribbon carrier, platen and rolls of paper.

Figs. 38 and 39 illustrate the locking plate whereby the platen carriage may be locked against longitudinal movement as when all the numerals are printed in a single column.

Fig. 40 shows the over-draft control mechanism and also the control mechanism for the ribbon shaft and for the platen feed, these elements being located in the rear left hand corner of the machine and being shown in Fig. 40 as looking toward the right.

Fig. 41 shows some of the parts of Fig. 40 as viewed from the rear of the machine.

Fig. 42 illustrates the motor control at the right hand side of the machine and particularly the clutch mechanism, whereby the continuously rotating motor may be connected in to actuate the main drive shaft.

Fig. 43 shows the motor shaft and the worm gear used for reducing the speed.

Fig. 44 is a transverse section through the worm gear drive showing the concentric tubes whereon are mounted the ratchet wheels, one used for connecting the motor to driving the calculating mechanism and the other used for connecting the motor to shift the platen carriage.

Fig. 45 is a perspective view of the ratchet and clutch mechanism on the right hand side of the machine, whereby the motor is connected in to drive the calculating mechanism.

Fig. 46 shows the clutch mechanism on the left hand side of the machine, whereby connection is established between the continuously rotating motor and the carriage, so that the carriage may be shifted from side to side to print added items in one column and subtracted items in another and to otherwise regulate the shifting movement of the platen carriage.

Fig. 47 is a perspective view of the clutch mechanism of Fig. 46.

Fig. 48 shows in section the adjustable stand whereon all the operating parts are carried.

Fig. 49 is a detail of the toggle connection for shifting the weight from the casters to the feet.

Fig. 50 is a perspective view of the complete machine mounted on its stand, parts being broken away to show the toggle connection.

Figs. 51 and 52 are perspective views of the sliding carriage and its co-operating parts as seen from the rear of the machine with the detachable paper support removed.

Fig. 53 is a side elevation on a reduced scale of the duplicator mechanism showing certain parts of the machine in section.

Fig. 54 is a partial front elevation of the same partly in section.

Fig. 55 is a partial plan of the same partly in section.

Fig. 56 is a perspective of the control plate and associated parts of the duplicator.

Fig. 57 is an elevation partly in section of the sliding table construction carrying the duplicator pinions.

General Operation—Figure 1.

The keys of the sectionalized keyboard are grouped in accordance with standard practice. Nine sets of keys are shown, but more or less may be used if desired. These nine sections are numbered respectively S_1, S_2, etc., to S_9. When any one section is removed, as for inspection or repair, it takes with it a portion of the internal mechanism of the machine, without, however, disturbing other sections or involving any material changes within the machine body.

Above the keyboard is a window or series of windows at which numeral wheels N_1, N_2 to N_9, and preferably some distance below them wheels D_1, D_2 to D_9, are visible, it being understood that wheels N_1, etc., form part of the calculating mechanism and that the total in the calculating mechanism may, at any time, be read off them, while wheels D_1, D_2 to D_9 are the duplicator wheels for retaining any number used in the calculations performed on the machine.

At the right hand edge of the keyboard is tripping rail R, which is so connected that the operator can touch it with the side of his hand without removing his fingers from the keyboard. When thus touched, the driving motor is thrown into driving connection with the machine and turns it through one complete stroke, or the tripper rail may be held down by the operator to repeat the operation.

Also at the right hand of the machine is lever L which can be swung either rearwardly or forwardly, respectively setting the machine for adding and for subtracting. For example, when it is desired to enter a certain number in the machine in a positive or adding direction, lever L is thrown rearwardly as in Fig. 1, either before or after the setting up of the keyboard and then the

operator touches rail R, tripping the clutch which connects the electric motor with the power shaft, and so rotating the calculator wheels to store up the number which had been set up on the keyboard. Simultaneously, this number is printed on the paper roll or sheet at the rear, the platen is shifted to advance the paper, and the printing ribbon is shifted to present a fresh surface and other incidental operations are automatically carried through.

A second item set up on the keyboard may similarly be carried through to the numeral wheels, which by their rotation will add the number to the amount already indicated by the wheels, this second item being simultaneously printed on the sheet of paper at the rear of the machine.

The printing and carriage mechanisms are normally always in operative relation so that any numbers set up on the keyboard and transferred through to the numeral wheels will simultaneously be printed to yield a permanent record.

Other items may be successively added in, each item serving to rotate the numeral wheels still further and so building up the total.

To subtract an item from another or from the total of previous additions or subtractions, control lever L is thrown forward, either before or after the number is set up on the keyboard, whereupon the tripping of rail R will again turn the machine over, but this time the numeral wheels will back up by an amount corresponding to the set-up on the keyboard, thereby, in effect, mechanically subtracting the number thus set up.

The items to be subtracted are printed, but the platen frame may previously be shifted over far enough to print the subtracted item in a separate column, so that added numbers are printed in one column and subtracted numbers are printed in an adjacent column. However, it is possible to print both added and subtracted numbers in either the adding column or the subtracting column through manipulation of carriage lock CL, whose function it is to

hold the carriage against movement so that if locked while aligned for the adding column it will continue to rest in that column whether the items are being added or subtracted at the numeral wheels and similarly, of course, if the carriage be locked in the subtracting position, all the items will be listed one after the other in the subtracting column even though some of them may be items actually added in at the numeral wheels.

At any time during the operation, it is possible to subtract out a number which has been added in by mistake (or similarly to add in a number subtracted by mistake) without allowing the carriage to shift over to the opposite column preparatory to making the correction, it being only necessary to throw the carriage lock CL and hold the carriage in the position which it occupied when the erroneous item was put into the machine.

In order definitely to identify negative items, no matter whether they are printed in a column by themselves or mixed in with positive items, a suitable character or mark is printed at the side of the number, as for instance a minus sign, which is printed in automatically whenever a negative entry is made, no manipulation of the machine by the operator being necessary.

Since the numeral wheels are actuated in a positive direction when lever L is set for adding, and in the negative or reverse direction when lever L is set for subtracting, the indications of the numeral wheels at the windows will always be the arithmetic sum of the numbers entered into the machine, since its last clearing, and exclusive of any "eliminated numbers" to be described.

To take a total and to print the total on the record sheet, the operator pulls down total lever TL, thereby shifting mechanism in such a way that the total as set up on the numeral wheels is backed out from those wheels when the machine is next turned over, thereby returning the wheels to their cipher positions, whereupon they shift out of mesh with their actuating racks and the

racks are allowed to return to normal. This leaves all of the number wheels at their initial or zero position. This backing out or unreeling of the numeral wheels serves to set up the printing mechanism so that it will print the total amount backed out from the wheels.

To retain the total in the machine (commonly called sub-totaling) sub-total lever STL as well as lever TL must be pulled down into their lowermost positions. These two levers are so locked that while TL can be pulled down without moving STL, it is not possible to pull STL down without its pulling TL with it. With STL and TL in their lowermost positions the machine, when turned over by tripping rail R, will back out the total from the numeral wheels, thereby setting up the printing mechanism to print that total, and then by retaining the wheels in mesh will again return them to their previous setting or in other words leave the machine with the total still in it.

In many machines it is considered necessary to lock the keyboard or the keys against movement when a total is to be taken, otherwise the machine may either print an erroneous total or be damaged. In the present machine the keyboard is not locked and yet the total cannot be tampered with and the operation of taking that total does not endanger the mechanism. This result is brought about by swinging the stop wires of the key mechanism forward out of stopping position, through the instrumentality of a rock shaft connected through suitable connections with total lever TL, so that when this lever is thrown forward into its total-taking position, the stop wires are out of the path of the swinging elements within the machine. Although the keys are not locked against movement they are effectually isolated from the rest of the machine during total taking and none of them can have any effect on the total or interfere with the swinging elements.

It is sometimes convenient, and even necessary, to enter a number on the printed record without adding it in at the calculating wheels, as for instance when the number of a railway car or the number of an invoice or other identifying data is to be put in as explanatory of the real numbers to be added or subtracted. In order to cause the printing of such explanatory items without actuating the calculating wheels, there is provided at the front of the machine an eliminating lever EL which serves to eliminate or keep out of the calculating mechanism the explanatory numbers which are to be printed on the permanent record. With lever EL in its lower position, it is in its normal or inactive position, and when raised, it is in position to compel the entry on the printed record of the number set up on the keyboard without allowing that set up to act on the calculator wheels. When such an explanatory or identifying number is printed on the record, there is also printed simultaneously and automatically an explanatory character in the nature of some special mark following the number, this character being sufficient to show that it is a box car number or the number of a bill of lading or the like and is not one of the numbers added or subtracted by the calculator mechanism.

Repeating mechanism is also provided so that the same item can be entered several times in succession, without the necessity for setting up the keyboard at each operation. This result is effected through a repeating lever RL, which when drawn down puts the machine in condition for repeating the number previously set up on the keyboard.

At the front end of each of the keyboard sections is correction key Ck which when depressed restores all of the keys to their raised position and clears out that particular section leaving it ready for a new impression. Thus when through error, the keyboard has been set up with the wrong number, such of the digits as may be in error may be cleared out by depressing the correction

key for their own sections of the keyboard and thereupon the correct key manipulation may be made and the machine put in condition for turning over to print the corrected number and adding or subtracting at the calculator wheels. As a short cut to extensive corrections of this character, total lever TL may be swung down and back, thereby clearing the entire keyboard but without affecting the calculator wheels or printing the item.

In the present machine it is possible to ascertain whether the machine is clear simply by glancing at the numeral wheels at the windows, without taking a total printing stroke as is necessary in other machines.

Inasmuch as the identifying character for a total is different from the identifying character of a sub-total, the printed record will always show whether a previous total left in the machine has been added into the new account or has merely been printed on the record simultaneously with clearing from the numeral wheels. This allows the operator to subtract it out later on, if through mistake it has been added in at the beginning.

The machine is also provided with means for indicating when it is being worked beyond its limit point. There is provided a printing character which comes into play, serving as a warning to the operator that he is in danger of getting a misleading total. In the case of an overdraft, the identifying or warning character comes into action immediately, and so long as the operator is beyond the negative limit with the machine in the subtracting position, this identifying character will be repeated after each item, even though the overdraft be no more than a cent. The warning character does not appear after items which are being added in to wipe out an overdraft as would be the case in a banking account where deposits are made which tend to reduce the overdraft of the account. After an overdraft has been completely wiped out, the warning character will disappear from the record and the machine

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having been returned from its abnormal condition beyond the limit point, will continue to add and subtract and will give the totals in the normal way.

The machine is so adjusted that when it is working beyond the limit point, either positively or negatively (either when the machine is nearly full or when there has been an overdraft) the total-taking mechanism will be automatically locked so that the operator cannot possibly take a total until the machine has been returned from its abnormal condition or from beyond the limit point.

The machine is also provided with a duplicating mechanism whereby any number at the time of its entry into the machine can be stored up in an auxiliary set of number wheels without interfering with whatever operation the machine is being called upon to perform and retained indefinitely until the operator at some future period desires to redeliver this number to the machine for any purpose. The number so stored up in the machine may be redelivered to the machine and cleared from the duplicator numeral wheels or redelivered to the machine and retained in the duplicator numeral wheels just as the operator desires. The controls for this mechanism are shown in Fig. 1, wherein DL represents the duplicator lever. To store up some number, for instance the number of a bill of lading or a box car number, independent of the calculating or printing parts of the machine for future redelivery to the machine, the operator shifts lever DL forwardly, whereupon the number is rolled into the duplicating numeral wheels D_1 to D_0, upon the turn-over of the machine, whatever operation the machine may be performing with that number. Lever DL is returned after this turn-over of the machine to its central position shown in Fig. 1. To redeliver this number thus set up in the numeral wheels D_1 to D_0, the operator shifts the duplicator lever backward, whereupon this number is delivered to the machine precisely as if it had been set up on the keyboard to

be employed in any operation of which the machine is capable, and at the same time cleared from duplicator pinions D_1 to D_9. To retain the number in duplicator numeral wheels D_1 to D_9 upon re-delivery of that number to the machine, he operates levers DL and DRL, whereupon the number will be redelivered to the machine but also retained in duplicator numeral wheels D_1 to D_9.

Keyboard.

(Figures 1 to 7.)

Fig. 1 illustrates the separate keyboard sections S_1, S_2, S_3 to S_9.

Fig. 2 shows one of the sections in its operative position, and

Fig. 3 is a diagrammatic view showing how a keyboard section operates.

The machine casing comprises base-plate 1, and a suitable covering hood having sides 2 and 3 and a top 4, the top having glazed opening 5 exposing the little windows at which numeral wheels N_1, N_2, N_3 to N_9 appear.

Each keyboard section comprises wall plate 6 arranged to support the key-stems, stop-wires and other operative parts of the section. At its front the plate carries flange 7 as wide as the operative parts of the section and serving to close the front of the keyboard when the keyboard is completely assembled. At the top edge of plate 6 is a flange or transverse plate 8 having slots to receive the key-stems. Keys K_1, K_2 to K_9 are mounted respectively on corresponding key-stems 9 each of which has a projection 10 to limit its downward movement and carries forwardly projecting lug 11 serving as a cam to actuate a stop-wire and also as a stop to prevent upward movement of the stem until it has been released subsequent to fulfilling its function in holding the set-up until the machine is operated.

Co-operating with lug 11 is swinging stirrup 12 (Figs. 3 and 4) pivoted at 13 and urged toward the key-stem by saddle-shaped

arm 14, also pivoted at 13 and having projection 15 constantly urged downward by coil spring 16. The upper end of saddle 14 is pivotally connected at 17 with stop-wire 18, the other end of which is bent at a right angle at 18' and is suitably guided to serve as a stop for mechanisms associated with the calculating wheels and printing mechanism. The lower end of each key-stem extends almost to the lower edge of plate 6. The extreme lower end of each key-stem is bent transversely and is attached to the lower end of spring 16 so that this spring fulfills not only the function of pulling down on saddle arm 15 to urge stop-wire 18 forward into stopping position whenever a key is depressed far enough to allow stirrup 12 to swing in over lug 11, but also forces the key-stem upward after the machine has acted and when the key-stem is to be returned to normal.

Projecting downward from each stirrup 12 is arm 19, which unlatches the stirrup from lug 11 when the keys are to be returned to normal and also positively restores the corresponding stop to normal. For actuating arm 19 plate 20 is slidingly mounted against supporting face 6 of the section and has lugs 21 extending transversely in position to strike arms 19 when plate 20 is shifted longitudinally. For shifting this releasing plate there is provided a lug or shoulder 22 positioned above a rock shaft 23 which has rigidly mounted on it striking blade 24 positioned to swing around into contact with lug 22 at each operation of the machine, pushing that hook to the right (Fig. 3) and shifting releasing plate 20 far enough to bring lugs 21 into engagement with arms 19, thereby swinging the stirrups away from lugs 11 and allowing the keys to return to normal. Coiled spring 25 attached to the rear end of releasing plate 20 restores that plate to normal after rock shaft 23 has turned back.

When a total is to be taken, this longitudinal shifting of the release plate is effected by rock shaft 26, which carries striking

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plate 27 for engagement with lug 28 on the releasing plate. This insures that all the stop wires will be "in the clear" or in the withdrawn position during totaling and prevents tampering with the total through manipulation of the keyboard.

In case corrections are to be made in the setting of the keys in any section, to clear out an erroneous set-up, preparatory to operation of the machine, recourse may be had to correction key CK, this key being movable downward against the tension of coiled spring 29 and having its lower end pivotally connected at 30 to bell crank 31 swinging about pivot 32 and having its upper arm pivoted at 33 to sliding link 34, the rear portion of which is notched to engage lug 35 projecting from the side of releasing plate 20. As a result, the downward movement of the correction key pushes link 34 toward the rear and shifts releasing plate 20 far enough longitudinally to release all the keys in that section, allowing them to return to normal. Sliding link 34 is so supported that it can be swung upward out of engagement with stop 35 so that after the machine has once started on its swing, the operator will be unable to change the keyboard setting by manipulating correction key CK. In other words the correction keys are thrown out of operative connection with sliding plate 20 at each operation of the machine, just preparatory to the swing of the machine, and that connection is not re-established until the machine has swung back to normal. To effect this result, the rear of link 34 is bent downward and provided with a foot 36 which bears on rocker bar 37 which moves upwardly at the beginning of each stroke of the machine to swing link 34 upward as described into dotted line position in Fig. 3 and it stays up until the very end of the stroke.

The details at the lower edge of plate 6 appear in Figs. 3, 5 and 7 and include three staffs, 38, 39 and 40, which slidingly support releasing plate 20, these staffs also carrying spaced plates 41, between which the lower end of the key-stems are guided and below

which the hooked ends of the stems protrude for engagement with their respective coiled springs 16. One of these plates serves as a stop to limit the upward movement of the key-stem. Plates 41 are held in position by brass rod 42 which extends through all three of the staffs 38, 39 and 40. This brass rod is in the nature of a key, the withdrawal of which releases outermost plate 41 and permits removal of all stirrups 12 and saddles 14 as soon as their springs 16 are unhooked and then allows all of the key-stems to be drawn out through top plate 8 and all of stop-wires 18 to be pulled forward out of their slots and removed from their section. The workmen can put these parts together without mechanical tools, using only their fingers to slip the parts in place, then hooking retaining springs 16 and sliding in locking key or wire 42.

Each time any one of the keys of a section is depressed, shoulder 43 near the upper end of the key-stem comes into driving engagement with a roller carried on stud 44 projecting from plate 45 mounted near the top of the section and swinging from three pivotal links 46. The main function of sliding plate 45 is to pull forward on the cipher stop as soon as any item has been put in on the keyboard by depression of any of the keys. This result is effected through pivotal link 47 (Figs. 3, 6), the rear end of which has a hook engaging with roller 48, carried on swinging plate 49, pivoted at 50 and carrying at its lower end pivotally supported stop-wire 51 (this being the zero or cipher stop-wire), the bent end of which slides in the zero slot of a pair of guiding segment plates 52. Coiled spring 53 normally pulls plate 45 rearwardly and also pulls the upper corner of plate 49 forwardly and so serves the double function of returning plate 45 to normal and resetting stop-wire 51 after each operation.

For returning the zero stop-wire to its acting position as soon as possible there is provided vertically sliding plate 54, the upper end of which has a slotted engagement with link 47 at 55 and the

lower end of which is slotted to receive vertically movable control rod 56 (Fig. 3) which is moved upwardly and downwardly in a positive manner at each operation of the machine and which pulls down on plate 54 just after swinging arm or stop-nose SN has passed stop-wire 51, thereby releasing bell-crank 49 and allowing its lower end to reset the zero stop.

It is not possible for the zero stop to hold the nose during a part of the forward swing and then release it for the balance of the swing for after the swing once begins the zero wire is effectively disconnected from the keyboard and depression of keys will not withdraw it. As soon as the forward swing is complete the zero stop comes into action and can be withdrawn by depression of a key even though the stop nose is on its return swing.

Thus at each operation of the machine and properly timed with respect thereto, control rod 56 moves down and stays down until the cycle has been completed or until the machine is again almost at rest, thus allowing the zero stop wire to move into stopping position the instant the stop nose has gone past it but giving the operator a chance to press down a new key set-up the instant the stop nose begins to swing back, or in other words, at the completion of a half stroke. The keys may then be depressed even though their stop wires happen to be in the path of the upwardly swinging nose, for in that case the nose will simply brush them back and slip past, the wires then returning to their set positions. The operator therefore can be very deliberate in working the keys for he has 50% of the total time of a complete cycle wherein to set the keys for the next operation as compared with 10% or so on the machines more generally in use. The return or upward movement of plate 54 will withdraw the zero stop, if in the meantime any key has been depressed so that the machine may make another downward swing instantly on return from, or completion of, the previous swing. If the operator wants to repeat an item he can do

so by simply holding down the appropriate keys and allowing the motor to turn the machine over as many times as the item is to be repeated. He is never thrown off the key-board for there is no forcible return of the keys.

This part of the machine is also provided with another vertically sliding control plate 57 which overlies plate 54 and in Fig. 3 largely conceals 54, and which comes into use when a total is to be taken by sliding upward to force its upper end 57′ against roller 48 pushing that roller backward and withdrawing the zero stop. This vertical movement is controlled through angle plate 58 at the lower end of plate 57, and the up and down movements of plate 58 are controlled by the total taking mechanism. Simultaneously with the upward movement of plate 57 to withdraw the zero stop to take a total, rock shaft 26 swings to bring its blade 27 into engagement with lug 28, thereby sliding releasing plate 20 and thereby sliding all of the saddles and stirrups rearwardly and withdrawing all of the stop-wires and leaving the stop nose free from danger of interference through manipulation of the key-board. The nose is free to swing through its full arc of travel which is necessary in order that the swing may correspond with the setting of the accumulator wheels.

In some machines it is considered necessary to lock the key-board when a total is to be taken. In this machine, on the contrary, the keys are not locked during the taking of a total and may be manipulated at will, because of the effective disconnection between the key-stems and their corresponding stop wires. This feature is of considerable importance.

All of the sections of the key-board are readily removable from the machine, each as a separate unit and altogether independently of the others and the others can continue to operate even though several of their companion sections have been withdrawn. Any of these sections may be removed by pulling out key-rod 59, pass-

ing through all the sections and the frame of the machine, and pulling the section forward and upward out of locking engagement with transverse cross bars 60, 61 and 62 of the frame from which it normally gets its support. To insure that the machine stands at normal when a section is being taken out, locking bar 62′ is provided, this being part of the main locking mechanism.

The Accumulator.

(Figures 2, 8, 17, 18 and 19.)

The accumulator mechanism as a whole includes pinions carrying numbered wheels, a swinging rack for each of these wheels, means for moving each pinion into mesh with its rack as the latter starts movement in one or another direction when the wheel is to be rotated (as when something is being added or subtracted) and for moving it out of mesh at the completion of the stroke. There is also included, mechanism for allowing the rack to slip with respect to the stop-nose by a distance equal to one tooth in either direction so that after one complete revolution of a numbered wheel, the amount so represented can be transferred through to the next adjacent wheel giving that adjacent wheel a movement equal to one tooth. This transferring mechanism also embraces a latch and trigger whereby this slip may be effective to carry over from one wheel to the next in either direction.

There is also provided mechanism for swinging the segmental racks, for swinging the stop-noses, for shifting the pinions into and out of mesh with their racks and for otherwise controlling the co-operative action of the several parts.

Each accumulator pinion 63 (Fig. 17) carries numeral wheel 64 and is pivotally mounted at the end of supporting arm 65 rigidly attached to rock shaft 66. When the pinion is in its uppermost position it is locked against accidental movement by retaining tooth 67, formed on bar 67′ spanning the side frames of the

machine, but when in its lowermost position it meshes with segmental rack 68 mounted for frictional drive from main rock shaft 69. Also frictionally driven from shaft 69 and in the same friction unit as is rack 68, is arm 70 carrying stop nose SN; this arm can swing down between stop-wire guide plates 52 until it strikes one of stop-wires 18 and its swinging movement will govern the swing of segmental rack 68 except that the segmental rack may slip one tooth backward or forward with respect to the stop nose and so can be made to carry across from one accumulator wheel to another. Rack teeth are formed on stop nose arms 70.

The mechanism whereby the slip between the segmental rack and its stop nose is effected comprises pivoted latch 71 carried by stop nose arm 70 and notched to engage with projecting lug 72 carried by segmental rack 68 and projecting outwardly from the side thereof, this being the rack which meshes with accumulator pinion 63. Latch 71 is controlled by pull wire 73 pivoted to swinging lever 74 which is pivoted at 75 and has its upper corner 76 positioned to strike against and to be controlled by laterally projecting lug 77 of trigger 78 pivoted at 79 and having at its outer end roller 80 which at proper times can be pushed down to lift stop 77 from in front of corner 76, thereby, through the action of coiled spring 81, allowing lever 74 to pull on wire 73 and swing latch 71 away from lug 72, thereby permitting the rack to move with respect to stop nose (or vice versa) by a distance equal to the pitch. Trigger lever 78 is tripped by cam 80′ rigidly mounted to turn with the next adjacent pinion 63 to the right in Fig. 1 and numeral wheel 64. The cam is of circular outline but with a projecting corner so positioned as to strike against trigger roller 80 of the section next adjacent while pinion 63 and its numeral wheel 64 are revolving from the "9" to the "0" position or vice versa. This is the point at which the wheel has fulfilled its function as an accumulator and must transfer or carry over to the next adjacent wheel.

When subtraction is to be performed all the accumulator pinions 63 go into mesh with racks 68 at the beginning of the down stroke of the racks and stop noses; when addition is to be performed, they go into mesh at the beginning of the up or return stroke. Now assuming subtraction is being performed; the stop noses each go down until they strike a stop wire. If a transfer is to take place, that is, when any numeral wheel 64 is turning from the "9" to the "0" position, its cam 80' will cause latch 71 to be depressed in the next adjacent section which will allow that rack 68 to move past stop nose 70 until lug 72 impinges the lower end of the slot in member 70, or a distance corresponding to one tooth. This movement of rack 68 relative to stop nose 70 is rendered possible by the slip joint connection between the two, both of these members being urged downwardly by shaft 69 upon which they are each frictionally mounted. Thus the accumulator or pinion next to the one turning from "9" to "0," is turned back one tooth. When addition is being performed precisely the same operation takes place, except that it occurs on the backward movement of stop nose 70. When the stop nose at the end of its backward sweep is stopped by bar 60 rack 68 (provided latch 71 has been tripped) moves on under the frictional impulse of shaft 69 until upper lug 72 comes into contact with the upper extremity of its slot, thus moving the corresponding accumulator wheel forward a distance of one tooth with respect to its stop nose.

For re-setting trigger 78 and trigger controlled lever 74, there is provided shaft 82 carrying a lantern construction embodying rolls 83 and 84 the latter of which performs the function of swinging lever 74 against the tension of its holding spring 81 when the parts are to be re-set. Lever 74 has cam projection 85 which swings forward when the lever is tripped and so is in the path of roller 84, which by striking this projection, will swing the lever back into position for latching and in so doing will force latch 71

forward to engage lug 72 and to lock stop nose SN with respect to the segmental rack, provided the latch and lug are in correct relative position.

Because of the slip joint connection between rack 68 and stop nose 70 whenever latch 72 has been released, the completion of the up stroke will always leave stop nose 70 held against bar 60 and rack 68 held by the contact of lug 72 with the upper end of the slot in member 70. Timed just ahead of the action at roller 84, the other roller 83 swings around into contact with projecting shoulder 85′ of segmental rack 68 and pushes that rack forward with respect to stop nose 70 by a distance equal to one tooth so that lug 72 will lie in the middle of its slot and in position to be caught by latch 71 when that latch is raised. This resetting of the stop nose and rack takes place at the completion of a full stroke of the machine.

Triggers 78 and coacting levers, together with their respective springs 78′ and 81, are mounted on L-shaped plate 87 connected by staffs according to what may be designated as "clock construction" and each L-shaped plate with its load of springs and swinging members is a unit in itself, and can be assembled by the assembler's bare hands and then slipped into position from the back of the machine, with its front recessed end embracing main upper cross bar 60 slotted to receive it. L-shaped plates 87 are positioned to receive and to be secured by the same locking rod 59 which holds the key-board sections in position. The upper or rear end of plates 87 is shaped to embrace the upper rear transverse frame member 88.

The lantern structure comprises end plates 82′ carrying rollers 83 and 84; the whole lantern being rotatable on shaft 82. Plate 82′ has an extended rounded corner 82*a* to which is pivotally connected link 82*b* the other end of which carries a pin mounted in curved slot 82*c* in wing extension 82*d* on plate 154′ carried by

shaft 155. Link 82*b* is normally held in its forward position by spring 82*e*. Pin 82*f* projects forwardly from the side frame which serves as a stop for plate 82′ and also engages the hooked end of link 82*b* when the link is in forward position. When the machine is at rest with plate 154′ in rearmost position, the lantern structure assumes the position shown in Fig. 10, wherein rollers 83 and 84 contact with lugs 85′ and 85 respectively (Fig. 17). As soon, however, as the forward stroke of plate 154′ begins, link 82*b*, under the influence of spring 82*e*, follows the plate until its hooked end engages pin 82*f* whereupon link 82*b* comes to rest while plate 154′ continues. In this position rollers 83 and 84 are off-set with respect to lugs 85 and 85′ and rearward extension 82*a* on plate 82′ has been swung inwardly. The parts remain in this position until plate 154′ has returned to a position wherein the forward end of slot 82*c* impinges the pin in the end of link 82*b* whereupon the hooked end of link 82*b* is disengaged from pin 82*f* and the parts are returned to the position shown in Fig. 10, aligning racks 68 and 70 and causing latch 71 to engage its lug.

Slip Joint Drive for Type Carriers and Stop Noses.

The slip joint between main rock shaft 69 and stop nose arms 70 and segmental rack arms 68 comprises a series of spools 89 and collars 90 which have key-ways to receive feather 91 on shaft 69; these spools and collars can slide along the shaft but must always turn with it. On one side of each collar is type-bearing lever 92 running back to the rear end of the machine and carrying the removable type head corresponding with one of the key sections; the other end of that lever constitutes arm 70 which carries at its front end the stop nose whereby the swing of the segmental rack is regulated. On the other side of that collar is the segmental rack arm 68.

The connection between each collar and its co-operating arms 92 and 68 is effected by means of flanges, one carried by the collar

and the other carried by the adjacent spool so that these arms need not come in direct contact with main rock shaft 69. To insure perfect wearing and perfect surface, each of swinging arms 92 and 68 is faced on both sides with babbit disks 92′ and 68′ cast in place and accurately surfaced before the machine is assembled. Small holes may be drilled through the arms so that the cast disk on one face will be intimately connected with the cast disk on the other face. To insure uniform wear and lubrication, rock shaft 69 is made hollow and provided with an oil feed at one end and with radial ducts leading out to an oil groove at each slip joint.

To insure a constancy in the slip and a uniform tension on the various parts of the slip joint, there is provided at one end of the rock shaft helical spring 93 which is coiled about the rock shaft and presses directly against the end disk, this pressure being transferred across from one collar or spool to the next, the series terminating in disk 94 permanently pinned to the shaft. Spring 93 is housed in box 93′ (see Fig. 19) and on assembly is adjusted to proper tension, which never need be changed in normal use.

Type-Bearing Heads.

(Figures 23 and 27)

At the printing end of each of printing arms 92 is a removable type-bearing head comprising a pair of side plates 97 and 98 riveted together to form therebetween rectangular chambers in which printing type 99 are slidingly mounted. Coiled springs 100 are disposed in the spaces between adjacent type and engage with pins 101 projecting from the side of each type, it being the function of these springs to return the type to their retracted position after they have been struck by the hammers. This entire type-bearing head locks into the end of swinging arm 92 by thin

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spring metal plate projection 102 co-operating with a pair of headed studs 103 and 104. Stud 104 can be inserted through an opening in arm 92 and stud 103 can then be swung around into the slotted end of that arm and then plate 102 can be snapped over behind retaining stud 105, thereby locking the type-head on the end of the arm, but in such a way that it can be removed without the use of any tool other than a pen-knife. The type-head bears on its side thin metal segmental strip 106 projecting outward somewhat beyond the retracted position of the type to serve as a ribbon guard.

The Hammer Section.

(Figures 21 to 27.)

This comprises a pair of side plates 107 and 107′ connected by cross bars to form a rigid frame wherein hammers 108 are pivotally mounted on transverse rod 109 about which they may swing to bring their upper striking ends into engagement with appropriate type after type-carrying bar 92 has been swung into a position governed by the swing of the corresponding stop-nose.

The striking power of each hammer is controlled by coiled spring 110, the tension of which may be adjusted through crank arm 111 carried by shaft 112, the end of which terminates in a crank (Figs. 21 and 24), controlled in position by a nut carried on adjusting screw 114 arranged at the side of the hammer section and accessible to a screw driver.

Each hammer comprises finger 115 whereby it is retracted from the type to a striking position, this retraction being effected in two separate steps. The hammer also includes projecting lug 116 whereby the arm may be prevented from striking in case it is to be held inactive for that particular operation of the machine. To effect this control of the hammers, the mechanism includes swinging lever 117 pivoted on cross rod 117′ having notch 118 for the

reception of lug 116 and having notch 119 for receiving cross bar 119′ on the lower forked end of pendulum lever 121, the upper end 121′ of which (except in the case of the outermost lever) normally supports the type-bearing head and is released as soon as that head starts on an upward movement. Lever 117 is cut away at 120 to permit an upward swing far enough to lock lug 116 against stop 118, when occasion may require. In other words, this pendulum lever is held in normal position by the weight of the type-bearing head, and can swing from that position only when released by the head. Coiled spring 122 pulls up on lever 117 and pulls down on a projection of lever 121 in such a way that it tends to swing the lower end of the pendulum lever forward toward the pivotal point of lever 117. The extreme rear end of lever 117 engages with control bar 123 carried by arm 124 actuated from rock shaft 125. Also there is provided rotating "X" bar 126, the function of which is to raise the hammers in position for striking and to drop them at the proper instant and then, almost immediately, to retract them out of contact with the rear of the type so that the type-bearing arm may be free to swing into another position.

The driving connection for swinging rock shaft 125 to control the position of bar 123 and its co-operating lever 117 comprises crank arm 127 (Fig. 21) rigidly secured to rock shaft 125 and bearing against the outer edge of cam disk 128 mounted to turn with "X" bar 126 and having its edges provided with four notches, each comprising two parts of different depth. With the elements in normal position, Fig. 21, crank arm 127 rests in the deepest of these two portions.

Lever 121 never rests against the shoulder nearest recess 120, but is suspended above it free to move over as soon as the type-heads are lifted. The part is cut away at 120 to permit lever 117 to move up when lug 116 is to be caught by stop 118. There is

clearance enough for the pendulum lever to swing and it is only prevented from swinging by the weight of the type-heads.

When a type-bearing head starts upward in accordance with a setting of the key-board, it frees the upper end of pendulum lever 121, leaving its lower forked end free to move over until the edge of notch 119 is against stop 119'. The several parts remain undisturbed with the pendulum resting against stop 119' until about two-thirds of the full forward stroke of the machine and then "X" bar 126 and its cam disk 128 turn slowly, shifting crank 127 and so lifting bar 123 to release lever 117.

On further rotation of "X" bar 126 the hammer is swung back to striking position while simultaneously swinging lug 116 forward into position for locking with notch 118 unless lever 117 is being held down by the lower end of pendulum lever 121, as it will be held down if that pendulum has been allowed to swing because of upward movement of its type head. Each type head controls its own hammer and unless the type-head moves up, the hammer will be caught by its lug 116 and will not strike against the type when released through further rotation of "X" bar 126. The timing of rotating bar 126 and movable rod 123 is such that first the pendulum lever is released and swings forward against stop 119, then rod 123 lifts, allowing lever 117 to come up as far as is permitted by pendulum lever 121. With that lever 121 in its forward or acting position complete upward movement of lever 117 is impossible and the hammers are free to swing back and strike, wholly under the action of rotating "X" bar 126. Bar 126 by its rotation lifts the hammers forward and drops them back with a striking blow. Almost immediately, however, it lifts them away from the type again so that the type heads can swing back into contact with upper end 121' of pendulum lever 121, which is thereupon swung back to normal position. The second lifting of the hammer is delayed just long enough to permit the transfer plungers to carry across the entire printing section.

In the special case where the hammer is not to print a zero or anything else, the type head will not lift from the pendulum lever and lower end 121 of that lever will not limit the upward swing of lever 117 with the result that when the hammer is drawn back by "X" bar 126, its release will carry it no further than until lug 116 strikes against stop 118. Nothing will be printed on the paper.

However, there is the special case that in printing numerals followed by ciphers it is necessary to print in the cipher without an upward swing of the type-carrying head and this is taken care of by transfer mechanism including sliding plunger 129 for each hammer, movable in a suitable guide-way and having its lower looped end 130, offset as shown in Fig. 24 and shaped to embrace the end of lever 117 and to engage the upper edge thereof for driving that lever downward when occasion requires. The upper end of plunger 129 is in position to be struck by tail 115 of the hammer member, and it is this blow transferred across to next adjacent lever 117 which unlatches the adjacent hammer and allows it to strike the zero type of its section. This unlatching is automatically transferred across from one hammer to the next on the right and so includes in the printing, all of the necessary ciphers.

Control Mechanism for Adding and Subtracting.

The control mechanism (Figs. 8, 11 and 12) determines whether the machine shall add or subtract when a certain number has been set up on the key-board. This mechanism includes hand lever L pivoted to the machine frame, which, in its rearward position, Fig. 11, is in the adding position, but which can be swung forward into the subtracting position. When tilted backward, Fig. 11, roller 131 on lever L passes down over the lower lip of the recessed end of rock lever 132 on shaft 189 and swings that lever upward at its rear end, thereby pushing upward on link 133, the upper end of which carries roller 134 movable in the slot of plate

135, to which is rivetted plate 135′. The construction permits roller 134, which has a flange on the inner side of slotted member 135 to pass the pivot of this member. Plate 135 has projecting arm 137 at its rear end, having a cam slot to receive roller 138 carried on the lower end of swinging arm 139, this arm being rigid on rock shaft 66 and serving to control the inward and outward swings of supporting arms 65 which carry accumulator pinions 63, numeral wheels 64, stop cams 80′ and totaling stops 80*a*.

Pivotally connected with the stud of roller 134 and with the upper end of link 133 is another link 140 pivoted to the upper end of plate 141 pivoted on stub-shaft 142 and having roller 143 at its lower end and offset retaining lug 144 at its rear edge. Auxiliary plate 145 is pivotally mounted on stub shaft 142 and can swing with respect to plate 141 and is used to put that plate under tension at each forward or backward swing of the machine so that numeral wheels 63 will snap into or out of mesh at appropriate times. To effect this there is interposed between plate 145 and plate 141 spring 146 which is coiled about shaft 142 and has both of its ends projecting upward divergently, these ends being respectively anchored in guide plates 147 and 148, both of which are free to swing about shaft 142 and serve merely to hold the ends of the spring to their work. With the elements as in Figs. 11 and 12 spring-supported guide plate 147 will contact with stud 150 on the upper end of lever 141 and the other spring-holding plate 148 will contact with stop 151 projecting from the top of swinging plate 145, thereby putting the two parts under tension and tending to swing stud 150 toward stop 151.

Referring to Fig. 8, the means for swinging plate 145 consist of a pair of studs 152 and 153 mounted on the outer face of main controlling plate 154 which is driven and turns on shaft 155 forward and back at each swing of the machine. The upper edge of plate 154 has laterally projecting flange 156 which serves as a

retaining cam for holding roller 143 against movement until the machine has reached just the proper point in its swing and thereupon releases that roller to allow plate 141 to snap over in response to the tension which in the meantime has been put on it through spring 146, for this spring meantime has been loaded by the swinging motion induced in plate 145 through engagement therewith of one or the other of studs 152 and 153. In other words the studs on plate 154 swing lever 145 backward and forward at every operation of the machine, thereby shifting the spring tension from one side to the other with respect to plate 141 and it is the function of roller 143 to prevent the parts from slipping through until the machine is in exact position and this exact position is defined by the release of roller 143, by controlling flange 156 projecting laterally from the upper edge of plate 154, roller 143 being confined beneath flange 156 on the first half of the turn over of the machine and above it during the second half thereof. The object of this mechanism is to shift accumulator pinions 63 into and out of mesh with racks 68 at the proper instant.

Fig. 11 illustrates the position of the parts before wheel 154 has begun its forward stroke and when lever L in its rearward or adding position. Roller 134 is then at the top of the slot in plate 135. The forward stroke of wheel 154 will operate first to lock roller 143 by means of flange 156 and then to swing the lower end of lever 145 by impact thereupon of pin 153. Upper lug 151 on lever 145 will move swinging arm 148 to the right and tension spring 146 without, however, shifting pin 150, for the reason that plate 141 is locked. As soon, however, as flange 156 has passed off roller 143 plate 141 is free to rock and under the tension of spring 146, applied through member 147 will be swung to the right. This will communicate a rearward impulse to link 140, rocking the slotted plate 135 in a clockwise direction, which

lowers arm 137 and by the caterpillar slot therein rocks lever 139 and causes accumulator pinion 63 to go into mesh with rack 68. The return of wheel 154 will first lock roller 143 in its new position, thus holding accumulator pinion 63 in mesh with rack 68 and thereafter pin 152 will impinge lever 145 putting tension on spring 146 in the opposite direction, so that at the end of the return stroke when roller 143 is released by flange 156, spring 146, acting this time through arm 148 will cause a forward impulse to be communicated to link 140, thus rocking slotted plate 135 in a counter clockwise direction, which, through the caterpillar slot in this member will swing arm 139 to the left and withdraw accumulator pinion 63 from mesh with rack 68. Thus, while the machine is adding, the accumulator pinions are held out of mesh on the forward stroke, put into mesh during the rearward stroke and automatically flipped out of mesh at the end of the rearward stroke.

The subtracting operation is analogous. In subtracting, lever L is in its forward position wherein lever 132 is tilted downwardly at its rear end, causing roller 134 to engage at the lower extremity of the slot in plate 135. Precisely the same operation of the remaining parts will cause accumulator pinion 63 to be held in mesh on the forward stroke, thrown out of mesh at the beginning of the rearward stroke, and flipped into mesh again at the end of the rearward stroke. This must be true because the operation of all the other parts being precisely the same in either case, in the subtracting operation link 140 (being lowered) communicates an impulse to the opposite end of pivoted plate 135 rocking this member in precisely the opposite direction each time to the direction it would rock it at the same stage of operation if adding were being performed. In reversing lever L in Fig. 11 from backward (addition) position to forward (subtraction) position it will be borne in mind that when roller 134 travels from the top of slot in

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plate 135 to the bottom that plate 135 will rotate on its center pivot and throw its upper end to its extreme right hand position instead of its extreme left hand position shown in Fig. 11, thus reversing the position of the numeral pinions with relation to the racks.

There is auxiliary plate 157 (Fig. 8) pivoted on stub-shaft 158 and having laterally projecting stop 159, which will ride on the top edge of rock lever 132 when that lever has been tilted upward at its rear end for the adding position. But in case of subtraction, and with lever 132 tilted down out of the way, auxiliary plate 157 swings forward at its lower end under the driving action of coiled spring 160 so that notch 161 near its lower end may engage with laterally projecting stop 144 located on the rear corner of swinging plate 141. When lever 132 is set for subtraction, projection 144 will snap in under the shoulder at 161 as soon as it is released at the end of the forward stroke, this having the effect of positively keeping the numeral wheels out of mesh with the segmental racks (on the return stroke) until other operations have taken place, including rotation of lantern shaft 82 and re-engagement of latches 71 with their lugs 72 to again connect each segmental rack in its normal relation to its stop-nose arm. Swinging plate 157 continues to lock plate 141 against return movement until main plate 154 swings back far enough to bring lug 162 against the lower offset end of plate 157, and thereupon that plate is unlatched and plate 141 can swing back under the driving impulse of its spring 146, which has long previously been shifted over to put the tension on in the other direction.

Thus, with lever L in the adding position, the accumulator pinions are out of mesh at the beginning of the forward stroke and are flipped into mesh at the beginning of the rearward stroke while for subtraction they are put into mesh at the beginning of the forward stroke, flipped out at the beginning of the rearward

stroke and positively held out until the beginning of the forward stroke.

To deaden or cushion the swing of lever 137 its rear end is positioned to engage with shoulders on a sliding plate 137′ (Fig. 9) movable up and down and frictionally retarded by a spring metal retaining plate 137″ having crimped ends engaged in the recessed ends of studs 137″ upon which plate 137′ is slidably mounted.

It is an important advantage to have adding lever L first lock the machine, when it begins to swing and at the extremity of its swing unlock the machine, substantially the entire swing of lever 132 taking place while the machine is locked. To bring about this, lever 132 has two lips 131*a* and 131*b* and a central aperture there between. In operation and supposing the parts to be as shown in Fig. 11, wherein the adding lever is in its rearward position and the forward end of lever 132 down, the adding lever may swing until roller 131 has cleared the lip 131*a* and passed the open space in the center and actually come into contact with lip 131*b* before lever 132 is shifted. The first part of this movement of lever L serves to lock the machine. After striking lip 131*b* roller 131 first gives lever 132 a quick short swing to set it to its upper or subtracting position; this comes about before roller 131 can continue in its movement. After lever 132 has been thus quickly shifted to its upper position, roller 131 can then continue to ride up lip 131*b* without having any effect on lever 132. It is this part of the movement which serves to unlock the machine. The lock mechanism for the adding and subtracting lever comprises swinging plate 185 to which is rigidly connected the plate 267 and having a rearward corner thereon adapted to swing across the path of block 186 on plate 154 effectually locking the machine.

Totaling Mechanism.

(Figures 2, 3, 8 and 10.)

The total-taking mechanism includes total lever TL pivotally mounted on rock shaft 163 and connected with adding and subtracting lever L by link 164 which is pivoted to total lever and which is connected to adding lever by slot and pin connection 164′ when total lever TL is in its rearward position. Lever L can be swung either forward or backward without disturbing total lever TL, but if the total lever is swung downward it necessarily takes with it lever L, thereby setting the mechanism in subtracting position, it being understood that in this machine the totaling operation is a partial subtracting operation and includes unreeling or backing out of the calculator wheels, the total of the items previously put in. Total lever TL is slotted at 165 for engagement with the end of link 166, the other end of which is pivoted to rocking cam plate 167, the cam way of which engages roller 168 carried on the lower end of crank arm 169 rigidly mounted on rock shaft 170. Rock shaft 170 carries hooks 171 (Fig. 10), the rearward ends of which serve as stops, and positioned to be swung around into abutting relation with lugs 80*a*, one of which is carried on the shaft with each calculator wheel 63 and its numeral wheel 64. Lugs 80*a* occupy a space of one pitch of the gear pinion, and the parts are so arranged that when hooks 171 are thrown rearwardly lugs 80*a* will bring numeral wheels 63 to rest in correct position to drop into mesh with rack 68. When a total is to be taken since lever L is thrown forward, all the numeral pinions 63 will go into mesh with rack 68 at the beginning of the forward stroke (as for a subtraction), pinions 63 will then revolve backwards until lugs 80*a* strike hooks 171. This position corresponds to the zero position of the accumulator wheels. Since the number in each accumulator wheel has been rolled out, the racks are set at whatever number was registered

n the wheels before the operation began. If the numeral wheel should register zero at the beginning of the operation, its lug 80*a* would, of course, already be in contact with the corresponding hook 171 and that rack would not be permitted to start. Thus the total will be backed out of the machine, and at the same time the racks 68 set in position to correspond with the amount of the total and the total printed as the machine is cleared. The accumulator pinions are raised out of mesh on the return stroke of racks 68, so that the completion of the operation will find the total printed and the machine clear.

As a part of the total-taking mechanism there is formed a slot 172 in the total lever plate TL and riding in that slot is a roller on the end of an arm 173 revolvably mounted on a rock shaft 174 from which shaft a rigidly mounted arm 175 extends rearwardly, Fig. 2, and supports the angle bar 58, whereby, through the action of vertical plate 57, the zero stop is withdrawn whenever a total or sub-total is to be taken and printed. The arm 173 has lug 173*a* thereon, which engages lug 174*b* on crank arm 174*a* on shaft 174 when arm 173 is moved in a counter clockwise direction, as viewed in Fig. 8, coiled spring 174*c* acting on shaft 174 normally keeps the arm 175 lowered.

The total-taking mechanism also includes swinging arm 176, having its front face shaped to engage with stud 177 projecting from the outer face of total lever TL, it being the function of this arm to swing on stud 176′, and induce a swinging movement in the downwardly extending arm 178 which is offset with respect to arm 176, but must move therewith. The lower end of this arm 178 is slotted and cammed to engage roller 179 acting through crank 180 to swing rock shaft 26 (Fig. 3) whereby blade 27 is swung upward against lugs 28 and shifts the releasing plate 20 to withdraw all of the stop-wires so that the stop-noses will not be interfered with by any of the keyboard mechanism, but will be

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free to swing in response to the setting of numeral wheels, or in other words until the stopping of those wheels by engagement of hooks 171 with stops 80*a*.

While the operator is swinging the total lever from its normal position to its active position, it is desirable that the machine be locked against rotation, and to effect this, there is provided on the lower edge of total lever plate TL, cam 181 which rolls over roller 181′ carried on bell crank 182 working against the tension of spring 183 and serving to swing the lower arm of that bell crank against roller 184 projecting from the side of stop-plate 185. When the operator starts to swing the total lever back, cam 181 rides up on roller 181′ and swings plate 185 downward into the path of stop-plate 186 carried on the side of main control plate 154, which acts as a brake thereby locking the machine against rotation until after the total lever has reached substantially its forward or working position and thereby has swung its cam 181 beyond the roller of plate 182 far enough to permit locking plate 185 to move upward again to the clear position.

The lower edge of total lever plate is cut away at 187 so that the shoulders thus formed can act in conjunction with shaft 189 (which carries lever 132) to limit the swing of the total lever.

The sub-total STL is of the shape shown in Fig. 14 and has its lower edge provided with a cam face 190 so that it can also serve to swing bell crank 182 and force locking plate 185 into position in front of main control plate. But this projection 190 on the sub-total lever has an additional function, in that it may swing forward to lie over arm 191 projecting forwardly from swinging plate 141; thereby acting to prevent that plate from swinging, irrespective of a shift in the tension device. Thus in taking a sub-total, the numeral wheels are thrown into mesh with the segmental racks and run along until stopped, but are not lifted out of mesh on the return stroke. They must run back

ver the same distance and thereby take up again the total which they had just given up to the printing mechanism. In other words this projection 190, co-operating with arm 191 insures the retention in the calculator of the total, which has been printed out, in this respect differing from the operation when total lever TL only is depressed, for in that case the total is printed out and the machine is cleared.

The sub-total lever is connected with total lever TL through stud 193 which strikes against an inwardly projecting extension of stud 177, so that although the total lever can be pulled forward without disturbing the sub-total lever, it is not possible to pull the sub-total lever without also swinging the total lever with it. It is this forward swinging of the total lever that sets all of the various total-taking mechanism and it is the forward swing of the sub-total lever that so locks swinging plate 141 as to insure return of the total into the calculating wheels.

The Repeater Control.

(Figures 3 and 8.)

To insure repetition in the machine, as repeated additions, or subtractions, or printing, without setting up the keyboard each time, there is provided at the front of the machine the repeat lever RL pivoted on short shaft 194 and limited as to length of swing by stud 195 running in a slot. The lower corner 196 of this rock lever plate carries a roller running on the cammed face of irregularly shaped plate 197 pivoted at 198 and having its rear end provided with laterally projecting flange 199, the function of which is to drop down against the forward end of bar 200 and force that bar down against the tension of its spring 201, thereby unlatching it from pin 202 carried by crank 203 mounted on rock shaft 23 which has the function of shifting the release plate to return the key-stems and stop-wires to normal.

With rock shaft 23 thus rendered inactive the original key settings will remain undisturbed and the machine may continue to operate any number of times, repeatedly adding or subtracting and printing that set-up, without clearing the keyboard. On return of rock lever 197 to its inactive position, as shown in Fig. 8, bar 200 will again swing up into driving relation with pin 202 and the keyboard will be cleared at each swing of the machine.

In order that the machine may be locked while the repeating lever is being shifted from its up position to its down position and likewise to prevent any operation of the machine when the repeat lever is not exactly in one or the other of those positions, there is provided in the lower edge of that lever, a pair of notches separated by cam face 204, the function of which is to force downward on the end of bell crank lever 205 pivoted on shaft 206 and having its lower rear end connected through link 207 with the forward end of locking plate 185, whereby main plate 154 may be locked against rotation. With the repeat lever in the upward position the rollered end of lever 205 lies in a recess and the machine is not locked and similarly when the repeat lever is in the downward position, the roller lies in the depression on the other side of cam face 204 and the machine is not locked but at any intermediate position bell crank 205 is out of normal and locking plate 185 projects down into the path of plate 186. Locking bar 62′ for the keyboard sections (Figs. 3 and 19) is carried by levers 205 and when depressed also serves to lock the machine against rotation.

Eliminating Numbers From the Calculator.

(Figures 8 to 13.)

To print various numbers on the record, as for instance box car numbers, and not add them in at the accumulator, there is provided eliminating lever EL.

This lever normally stands down, Fig. 8. It is pivotally mounted on stud 194 and has its lower edge notched to receive the roller of plate 205 so that it fulfills the function of locking the machine against rotation when this lever is not at its upper or lower limit, in this respect corresponding in action with the repeat lever RL. The essential part for securing the printing of a number without its addition or subtraction at the calculators, consists of roller or pin 208 which rolls around against the forward edge of rocking arm 209, the upper end of which is pivotally attached to a long push bar 210 the rear end of which is pivotally attached at 211 with the upper end of swinging plate 212, Fig. 13, the lower end of which carries hook 213, the function of which is to lock stop 144 of plate 141 against downward movement. The function of this hook is to prevent any movement of plate 141, irrespective of the shifting of its tension device, thereby preventing any swing of the arm supporting the calculator wheels and positively holding the calculator wheels against their retaining pins 67.

Also connected at the pivotal point 211 at the upper end of this plate is push bar 214 which extends rearwardly and upwardly, its outer end being supported and guided by stud 215 which is received in a slot in that bar. This bar 214 is cut away to lie over shaft 82 of the lantern structure (which is used to shift the segmental racks with respect to their stop-noses and to drop the latches in for holding these two parts in their proper normal relation).

Bar 214 carries shoulder 216 which, when the bar is thrust backward, comes into locking engagement with pin 217 carried by shaft 82 and so holds the lantern structure against rotation. The lantern structure is not positively rotated, but is merely released from its normal position, swinging through a limited arc by a spring (Fig. 10) and reset by a slot and pin drive from shaft

.55. Shoulder 216 acts as a detent to prevent the release of the lantern structure when the eliminating lever is up. The part 214 is somewhat superfluous, being in the nature of a duplication of the operation and function of the hook which holds stop 144 and the machine can be operated without this additional safeguard.

When the eliminating lever is up in its active position, swinging arm 209 has a lug on its rear edge forced in under stop-shoulder 218 formed in the front edge of the adding and subtracting lever plate. The result being that this plate is locked in the adding position, this being the position in which the numeral wheels are out of mesh with their segmental racks and also the position in which the total lever and the sub-total lever are locked in their normal position by cross link 164. It is not possible to disturb the normal setting of either of the total levers while the eliminating lever is in its upper or operative position. A total in the machine is thus protected and cannot be changed or eliminated.

The adding and subtracting lever L works through bell crank 219 pivoted on shaft 176' to move link 220 rearwardly, this link being pivoted at 184 to plate 185 and serving to force that plate down into the path of the plate 186 to lock the machine while the adding and subtracting lever is being shifted, so that the machine is locked when either the adding lever or the total lever or the repeat lever or the eliminating lever is being shifted. All of these locking mechanisms work through the downwardly extending arm 267 of plate 185 to control the effective connections between the motor and the machine. Thus the machine is locked whenever any control is being shifted.

Printing Special Characters (Fig. 9).

As to the means for controlling the printing characters such as the minus sign, the total sign, etc., these characters are arranged in a row on a swinging type-bearing head and that type-

..ng head is carried on an arm which is driven through a slip joint from main rock shaft 69.

This character arm C appears at the extreme left of Fig. 9 and its co-operating stop-nose lever SN projects forward in position for co-operating with a large sliding plate 221 having a series of notches 222, any one of which may serve as a stop for the stop-nose, provided plate 221 is drawn forward far enough. This plate 221 is connected up with eliminating lever EL and with subtracting lever L and with total lever TL and with sub-total lever STL, so that by operation of any one of these, the plate will be moved over far enough to allow some movement of stop-nose SN. Movement of eliminating lever will shift plate 221 so that stop-nose will enter as far as the first notch, operation of the subtracting lever will shift the plate to bring the stop-nose into the second notch, operation of the total lever will put it in the third notch and operation of the sub-total lever will put it in the fourth notch. The connections between the eliminating lever and sliding plate 221 comprise roller 223 secured near the lower edge of plate 221 and movable by means of bell crank 224 pivoted to a suitable support and having its upper end engaging with lug 225 carried on the side of long link 210, the rearward movement of which is effected when eliminating lever EL is swung upward into active position.

The connection between adding and subtracting lever L and sliding plate 221 is brought about through the swinging movement of long rock lever 132, for that rock lever carries at its lower edge a downwardly extending cam face 226, which on the upward swing of the front end of that lever presses against roller 227 carried on the lower end of side plate 228 bolted to the inner face of slide plate 221. This movement is sufficient to shift the plate over two of the notches at the stop-nose. When total lever TL is swung forward to take and print a total and clear the ma-

.ie, it exerts a forward push on stop 229, positioned at the upper edge of plate 221. This result is obtained through the action of an irregularly shaped plate 230 pivoted at 231 to the total lever and having its lower slotted end fitted over pin 232 projecting from the side of the sub-total lever. Then as the total lever is swung forward without movement of sub-total lever, plate 230 will rock on its pivot and will also swing forward, effecting a forward push on stop 229 by the upper face 230' of plate 230, moving plate 221 a distance equal to three of the notches for the stop-nose. If sub-total lever be swung forward simultaneously with total lever as when the machine is to print its total and retain the total in the calculating wheels, then as the forward movement of sub-total lever swings pin 232 forward, total lever goes with it, plate 230 does not rock and strikes lug 229 with its end 230" moving plate 221 back a distance of four notches.

Slide plate 221 may be held in place as by means of button 233 riveted to frame plate 234, the lower edge of plate 221 being held behind the head of stud 235 and the front end being held and guided by the head of stud 236. To dismember the machine, the plate may be drawn forward and slipped off over the head of stud 236.

The frame plate 234 is of irregular outline, Fig. 9, but fits in over the transverse frame bars 60, 61 and 62 and is removable therefrom in much the same way as the keyboard sections. The retractive movement of plate 221 is effected by coiled spring 237, which has one end fastened to the frame plate 234 and the other fastened to side plate 228, which is riveted to sliding plate 221. This spring draws the plate back into normal position, as soon as that plate is released by appropriate movements of the eliminating lever or the adding lever or the totaling lever.

Controlling the Zero Stops.

Fig. 9 also illustrates the mechanism for controlling the zero stops in the key-sections. This comprises a plate 238 pivotally mounted at 239 and having feet 240 and 241 to act as stops in limiting the upward or downward swing of each end of the plate by striking against cross bar 174. Beyond the keyboard section on the other side of the machine is a similar plate 238′ and these two plates serve as supports for cross bars 56 and 37. Cross bar 56, which is carried at the rear ends of plates 238 and 238′ operates to drop plate 54 and disconnect the zero stop from the keyboard immediately after the stop-nose has struck that stop or has passed it, thereby preventing a delayed release of the stop-nose in case a key is depressed during the forward swing of the machine and later, after the backward swing is nearly completed, it serves to lift vertical plate 54 and to withdraw the zero stop. This is useful in those special cases where a key has been depressed during the backward swing and before the machine has returned completely to normal, thus holding the zero stop back so that the forward swing can be begun immediately. If no key has been depressed on the backward swing, the upward movement of bar 56 will reset the zero pin and reconnect it through link 47 with the keyboard so that subsequent depression of a key may withdraw it.

Cross bar 37, Fig. 3, lifts up on rocking links 34 and thereby disconnects correction keys CK from releasing plates 20 while the machine is turning over.

The rear end of rocking plate 238 is normally pulled downward by coiled spring 241′ and the downward swing is controlled by stud 242 projecting from the side of disk 243 mounted on main drive shaft 155, so that as disk 243 begins its forward swing, stud 242 drops away from plate 238 and allows cross bar 56 to drop and these parts remain in that condition until the return swing of

the plate, when stud 242 again lifts the adjacent end of rock plate 238. This lowers and raises sliding link 54 to control the zero stop as heretofore explained.

Driving the Printing Mechanism.

(Figures 9, 21 to 24.)

The means used comprises pair of pushers 245 and 246 pivotally mounted along the lower edge of disk 243 and guided at their rear ends in a supporting structure 246, so that pusher 246 may engage one pin of rotary lantern 246′ and pusher 245 can engage the next pin. Pusher 246 gives a slight turning movement to the lantern and then reaches the dead center point with respect to shaft 155 and so remains practically stationary while pusher 245 is coming up to give a quick thrust to the next pin of the lantern. These two pushers thereby give an intermittent movement to the printing "X" bar and bring about the alternate release and positive retraction of the hammers.

The Motor Drive.

(Figures 8, 42 to 45.)

The motor drive includes electric motor 247 having its armature shaft connected through worm 248 and worm gear 249 enclosed in cup-shaped housing 250 bolted to supporting plate 251, carried by casting 252 depending from machine base 1.

Worm wheel 249 is keyed to tube 253 and serves to turn that tube in the bearings of castings 250 and 251. One end of that tube carries ratchet 254, which turns continuously so long as the motor runs. This ratchet serves as the driving element, the driving connection being established through the aid of pawl 255 which can be released to catch into ratchet wheel 254 and hold on until the pawl and co-operating parts have swung around through one complete revolution and have come back to their starting point.

The pawl is made to grab into ratchet 254 by means of swinging lever 256 pivoted at 257 and having its upper end connected by link 258 with the lower end 259 of a rock lever pivoted at 260 and having its forward arm 261 pivotally connected with one of the push rods 262 of the tripping rail R. The other push rod 263 of the tripping rail is connected through bell crank 264 and through link 265 with the lower end of rock lever 259, thereby equalizing the action of the tripping rail. The rearwardly extending arm 266 of rock lever pivoted at 260 reaches through (Fig. 8) to serve as a lock for the downwardly extending arm 267 of swinging plate 185, so that after tripping rail R has been pushed, locking plate 185 cannot swing downward to check the forward swing of the machine and similarly if plate 185 has been swung to check the machine (as through incomplete shifting of any of the hand levers at the top of the keyboard) it will be impossible to operate the tripping rail. In other words either arm 266 or arm 267 can serve as a lock for the other, by swinging across into the path of the other.

Pushing down on trip rail R swings the lower end of lever 256 out of engagement with forwardly projecting lug 268 on crank plate 269 and almost immediately thereafter releases the tail of dog 255 by moving outward beyond the end of it, so that under the action of its spring 270 that dog can catch into ratchet wheel 254 locking crank plate 269 to the ratchet and compelling the crank plate to throw over through one complete revolution of the ratchet. The tail of the dog is slightly longer than the tail of plate 269. Crank plate 269 is mounted on tube 269′ housed within rotating tube 253. This is a convenient way of getting a bearing surface for the crank disk support. As the worm gear ordinarily would run continuously in oil, its supporting tube may be perforated to permit entrance of oil between the tubes to give constant lubrication of the crank disk support. Pivoted to the

crank plate at crank pin 271 is pitman 272 which, as shown in Figs. 8 and 42, is pivotally connected to the lower end of main swinging plate 154. During this rotary movement of the crank plate, the crank pin 271, which carries roller 273 swings around and strikes against curved lever arm 274 swinging that arm rearwardly. The arm is rigidly mounted on rock shaft 275 which also carries another lever arm 276, having pivotal connection at its rear end with push bar 200 of Fig. 8, whereby the periodical rocking of shaft 23 is effective at mid-stroke to shift the releasing plate 20 rearwardly and relase all the key-stems so that they may return to normal. Arm 276 has a forward projection serving as a stop, by engagement with stud 277, thereby limiting the swing of shaft 275 and its arm 276. When crank disk 269 has made one complete revolution lever 256 will be in position to act as a stop and will serve, first to unlatch the dog and almost instantly to strike against projection 268, thereby checking further movement and holding the crank at its dead center with respect to the load. If the operator holds trip rail R down, the crank disk will continue to rotate and the machine will repeat its operations. A spring pressed latch 278 may be provided for catching the crank to prevent it from slipping back because of any tendency to rebound. This latch has a downwardly extending arm 279 bearing against a stud which serves to limit the upward swing of the latch. The coil spring 278′ yieldingly holds up latch 278 and yieldingly holds down arm 266 whereby the tripping rail is held upward and latch 256 in position to engage with crank plate 269.

The Carriage Driving Mechanism.

(Figures 46, 44 and 47.)

On rotating tube 253 at the end opposite from that used to turn the machine over is second ratchet 280 which shifts the carriage

.ongitudinally and has co-operating therewith dog 281 which can be thrown in to grip the ratchet when the shift is to be made. This dog operates in essentially the same way as the dog used for turning the machine over and has a rearwardly projecting tail 282 adjacent to a similar projection from crank disk 283, these projections being in position for engagement with hook 284 pivoted to swing from stub shaft 285 and having an upwardly projecting arm 286 connected through link 287 with similar arm 288 carrying another stop 289. For shifting the carriage, crank disk 283 makes one-half a revolution at each shift, the carriage traveling to the right for a half turn of the crank disk and then coming back to the left for the next half turn of that disk. Spring catches 290 and 291 may be relied on to hold the crank disk at its dead center, thereby preventing it from swinging back because of the weight of the connected parts, or because of any rebound or vibration.

The crank disk 283 is pivotally connected with pitman 292 which is pivoted to rock lever 293 carrying connecting rod 294 working through bell crank 295 to shift the carriage driving pin 296 back and forth along the line of travel of the carriage. When the carriage is in place, it has a link connecting with pin 296 and its longitudinal movements are controlled thereby.

For governing the action of dog 281, push rod 297 is pivoted to rock lever 293 and carries a pair of coiled springs 298, 299, adjustable in tension and both bearing against pin 300 of swinging arm 286. When the carriage is in one position, spring 298 is compressed and when in the other position spring 299 is under compression. With the elements in position, Figs. 46 and 47, spring 298 is under compression tending to force the hook away from the tail of dog 281 and tending to force stop 289 inward to a striking position, but movement is not possible because of engagement between a little lug 301 on the extreme upper end of arm

286, and a pair of lugs projecting downward at 302, one of which is mounted to swing with rock lever 303 pivoted at 304 and controlled in its movement by coiled spring 305, limit stop 306 and push rod 307, which rod runs up to the top of the keyboard and terminates at its upper end in the carriage-lock wing-piece CL. When CL is down the carriage shifting mechanism is locked at 302 and no shifting can occur, but when up, one of the stops at 302 is out of position and movement of carriage will be governed by the raising and lowering of the other stop. This other stop is carried on swinging arm 308 pivoted at 304 and controlled by coiled spring 308′, the free end of this arm carrying roller 309 which bears against swinging arm 310 mounted on rock shaft 311 which goes through to the other side of the machine, Fig. 8, and terminates in an upwardly projecting arm 312, the extreme upper end of which is bent over to lie in the path of arm 267, so that at each forward swing of arm 267 (resulting from the downward swing of the locking plate 185) there will be given a slight rotary movement to rock shaft 311 (each time any of the control levers is manipulated) and this slight rotary movement of shaft 311 is sufficient to lift arm 308 and allow stop 301 to swing by to the other side of its co-operating stop at 302, thereby unlatching the dog 281 and connecting in to the motor and so shifting the carriage across to the other side.

To shift the carriage, without changing from additions to subtractions or vice versa, the operator merely lifts control lever L or totaling lever TL for a small fraction of its complete throw, allowing it to snap back without completing the throw. This unlatches the holding means for the carriage pawl and allows carriage to be shifted over to the other side, leaving the control mechanism at the keyboard in the same setting as before.

Overdraft Mechanism.

The overdraft or limit (Figs. 10, 40 and 41) locking mechanism locks the total mechanism to prevent taking a total when more has been subtracted out of the machine than has been put in, and is so adjusted that after additions have been made sufficiently to build up a total in which the last accumulator wheel is loaded to its capacity, the total-taking mechanism will become locked and no total can be taken until the calculator has been returned from this abnormal state.

It comprises trigger 320 pivotally mounted at 321 and having its outer free end positioned under the numeral wheels and carrying platform 322 lying in the path of cam 323, which in appearance and position is like the cams 80′, but which has a function quite different.

The other end of lever 320 has its upper edge bent over horizontally to form stop 320′, which normally lies in the path of the upper end 324 of swinging arm 325 mounted to swing on frame stud 326 and having its front edge formed into a shoulder at 327 to bear against the lantern structure which swings about shaft 82 as a center.

Unless the last number wheel and its cam 323 is in the "9" position lever 320 will have its stop 320′ in the path of upper end 324 of lever 325 and lever 325 cannot swing forward as the lantern structure rotates. But in case of repeated additions until the total has increased so far that the last numeral wheel is in the "9" position, cam 323 pushes down on platform 322 of lever 320 and unlatches arm 325, allowing that arm to swing forwardly toward the keyboard as plate 82′ comprising one end of the lantern structure is rotated, and by so doing, turn on stud 326. But pivotally mounted on stud 326 and offset somewhat with respect to lever 325, but swinging therewith, is downwardly extending arm 328 controlled in its movement by coiled spring 329 (Fig.

10), and being pivotally connected at its lower end to link 341, the main body of which is shown in Figs. 22 and 23. It runs rearwardly for connection to crank arm 342 on shaft 343, having bearings in plate 107′ of the printing section. Shaft 343 carries horizontal crank arm 344, the rearward end 345 of which serves as a stop for finger 346 integral with the last pendulum member 121 on the left, which particular pendulum member has its upper end cut off so that it does not have the upwardly extending stop 121′. Link 341 is on the left hand side of the machine, but rock shaft 343 crosses over through the printing mechanism from one side to the other so that the danger signal is printed to the right of the subtracted item. The action of these parts is such that link 341 is pushed rearwardly through the effect of adding into the machine enough numbers to make the last numeral wheel show a "9" and the resulting release of the pendulum 121 will operate to hold stop plate 117 in its down position and allow lug 116 to clear stop 118, thereby permitting the hammer to strike against the type, and the type in this instance is a single type member 347, Fig. 24, carried at the end of stationary bracket 348, bolted to side member 107 of the hammer section. Thus, in case the calculating section is reaching almost its full capacity, the overdraft or limit character will appear on the paper as a warning.

In case of overdraft, and by this I mean subtracting out from the accumulating mechanism more than there is in it, the carrying mechanism will have the effect of setting the last or left hand wheel at the "9" position, even though but a single cent or unit be subtracted. This overdraft then has the action of bringing the cam point 323 of the last numeral wheel into contact with platform 322 of lever 320 and thereby through the action of swinging arms 327 and 328 and link 341 and its co-operating crank arms 342 and 344 acting in the hammer section to print the overdraft character or signal at the side of the subtracted item.

The overdraft mechanism also locks the machine against totaling whenever there is a "9" showing on the last wheel of the calculating mechanism. This result is attained as follows:

Mounted on the side of swinging arm 328 (Fig. 10) is roller 349 which controls the movement of upper arm 350 of bell crank pivoted at 351. The lower end of the bell crank consists of hook 352 which can engage the front end of swinging latch arm 353 pivoted at 354 to a stationary frame stud, latch arm 353 being riveted to swinging arm 355 connected at 356 to the slotted end of long horizontal link 357 which extends forwardly along the base plate of the machine and terminates in an upwardly curved portion pivoted at 358 to the upper end of crank 359. This crank is rigidly mounted on rock shaft 360, which also carries a downwardly extending arm 361 to serve as a stop when it strikes the bottom plate of the machine. Shaft 360 carries in addition to arm 359 a similar upwardly extending arm 362 (Fig. 8), the upper end of this arm being notched at 363 so that it can swing in under stud 364 carried on the forward edge of the control plate of total lever TL, thereby to serve as a lock for the total lever, preventing the operator from throwing that lever under certain conditions of the overdraft mechanism.

The energy necessary for shifting the long horizontal link 357 (Fig. 10) to throw in the lock for the total lever is furnished by a little coiled spring 365 located at the extreme lower and rear corner of the machine (Fig. 10), the spring there being shown as broken away at its middle, but having its rear end attached to frame stud 366 and its front end attached at 367 to arm 368 pivoted at 369 to crank arm 355. The forward end of arm 368 can slide back and forth over the adjacent cross member of the machine and it is the full function of this member 368 to furnsh an anchorage for coiled spring 365 and to permit the use of a long spring.

Thus, when the machine enters the overdraft condition, stop 340 will swing arm 350 to unlatch hook 352 and the backward movement of link 357 will lock total lever TL against movement until the machine has been returned from its overdraft setting. After the calculating section has returned from its overdraft condition, the first full operation of the machine will unlock the total lever so that the total can be taken. This result is attained as follows:

Main drive shaft 155 carries control plate 154′, and pivoted to the side thereof is a long upwardly inclined link 370, the rear end of which is pivoted at 371 to the upper end of rock beam 372, pivoted to swing about the center 354 and carrying at its lower end stud 373 positioned to swing forwardly and strike against arm 355 working against the tension of the big spring 365 and serving to swing latch 353 upward into engagement with hook 352 so that after the hook has been released by an upward swing of arm 328 (this result being attained by return of overdraft lever 320 to normal) hook 352 will latch under arm 353 and hold all the parts in normal position with total lever TL free.

Ribbon Shift.

(Figs. 28 to 40.)

Power for unwinding the ribbon comes in to swinging arm 374 (Fig. 28) through recessed block 375 which fits over a lug on member 372 (Fig. 40), that member having a to-and-fro motion, each time the machine turns over. Arm 374 is pinned to the lower end of vertical rock shaft 377 (Fig. 33), the top end of which has crank arm 378 (Fig. 34), to which is attached link 379 extending across to the opposite side of the ribbon carrier and there connected with a corresponding crank arm 380 clamped to another vertical rock shaft 381. Thus, when power comes in from the machine through swinging arm 374 to move that arm back and

forth at each movement of the machine, both of the vertical rock shafts 377 and 381 swing equally through a small angle. Mounted to turn on each of these rock shafts is a ribbon-carrying spool made up of central hub 382, top flange 383 and bottom flange 384, the top flange making frictional contact with one end of leaf spring 385, the other end of which extends across to form a bearing for vertical guide roller 386 over which ribbon 387 passes in going from one spool to the other. Below lower flange 384 of each drum and normally free to turn with respect thereto, is gear 389, which comes into action whenever the direction of ribbon movement is to be changed and for bringing this gear into action there is provided on each spool a swinging flap 390 over which the ribbon is wound. This flap carries at its lower end finger 391 projecting down through a slot in spool flange 384 and engaging with one end of pawl 391′, the toothed end of which is spring pressed (see Fig. 32) to engage with the teeth of gear 389 when the ribbon has been unwound from the spool down to the last turn, or far enough to release flap 390 and so release the free end of the pawl and allow its working end to engage with the gear teeth.

The movement of the spools in one direction or the other is brought about by a pair of swinging plates 392 and 393 pivoted respectively at 394 and 395 to arms 374 and 380 and each serviceable as a pawl to permit forward movement of its own spool, but under certain conditions to prevent return movement thereof. These swinging plates are so connected that only one of them is working at any particular time. Each swinging plate is provided with coiled spring 396 so that it yieldingly engages in the notched edge of lower flange 384 of its spool and since the pivotal support for plate 392 moves with the swinging arm 374 and pivotal support 395 of the other plate 393 swings with similar arm 374′, one or the other of the swinging plates can serve to push on the

notched edge of its spool flange and thus advance the ribbon in one direction or the other at each swing of the machine. These swinging plates carry tails provided with rollers 397 and 398 which bear against the edge of a long sliding plate 399 having notches at 400, 401, to serve as cam faces to govern the position of those rollers and thereby to govern the setting of the swinging plates. This long sliding plate 399 shifts longitudinally each time the ribbon has been completely unwound from one or the other of the spools, the shifting movement being induced by connecting bar 402 connected to swinging arm 403 which is pivoted at 404 and is shifted with a quick snap by the mechanism now to be described.

When the ribbon has been unwound from a spool down to the last turn, flap 390 will release and its finger 391 will allow pawl 391′ to grip gear 389 and further movement of the spool will cause rotation of that gear and consequent rotation of another gear 405 meshing therewith. Gear 405 is on shaft 406 to which is splined drum 407 (Fig. 34) carrying one end of chain 408, which passes over sheave 409 (Fig. 28) and around winding drum 410, to which it is attached. The chain continues over sheave 409′ and is similarly attached to another drum (similar to drum 407) adjacent to the opposite spool. Rotation of gears 389 and 405 therefore causes rotation of drum 410, either in one direction or the other in accordance with the direction of movement of the ribbon. Immediately below drum 410 is cam disk 412 free to turn about the pivotal center 413 of the drum and having a cutaway portion 412′ by which it is controlled in its movement by stud 414, positioned at the pivotal connection between two swinging arms 415 and 416, the former of which swings about center 413 below cam disk 412 and the latter about stud 417 and is slotted to move longitudinally with respect to that stud and has spring 418 impelling toward the cam plate 412 which it serves to govern.

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Stud 414 under the impulse of spring 418 bears against the end of slot 419 in drum 410 and when that drum rotates is pushed back against the tension of spring 418 until it passes the dead center line with respect to the centers 417 and 413 and then jumps to the other end of slot 419 and so gives a quick throw to arm 415 and a quick snap to cam plate 412. This cam plate 412 has a working face 420 which can pass into contact with rollers 421 and 422 mounted on pins projecting from the plate 403 which swings about pivot 404 to move bar 402 when plate 399 is to be shifted. The swinging of cam plate 412 swings arm 403 and shifts plate 399 and cam faces 400 and 401 shift with respect to their rollers, releasing one of the spool engaging plates and throwing the other into action. This reverses the direction of movement of the spools and so winds up the ribbon the other way and thus the ribbon will automatically wind up and unwind, and the shift from one spool to the other is made with a snapping movement and the ribbon never has a chance to get slack, even at the instant of reversal.

In addition to the unwinding of the ribbon from either spool, it has an up and down movement to bring all parts of it equally into use. This is effected through an arm 423, Fig. 40, which in normal operation is given a slow up and down movement by cam 424 moving with ratchet 425, the rotation of which is effected by pulling bar 426 pivoted to rocking plate 372 which swings about center 354, at each operation of the machine. Arm 423 is attached to one end of rock shaft 429 (Fig. 28) and that rock shaft carries a pair of arms 430 each of which projects forward toward one of the spools and is connected through link 431 to plate 432 (Fig. 33), which underlies the corresponding ribbon spool, thus when the rock shaft turns, the toggle pushes up on plate 432 and moves the spool progressively along its supporting shaft 377 sliding it slowly up and down to change the relative position of the ribbon

and the type. The ratchet plates 392 and 393 are broad enough to engage with the notched lower disk of the ribbon spool, irrespective of its altitude and so need not be raised and lowered, but substantially all of the other parts of the ribbon-carrying mechanism move with the ribon in response to the shifting of arm 423 and its associated toggle connections.

Carriage Mechnism.

(Figs. 35, 37, 46 and 49.)

A carriage for the platen and the rolls of paper is positioned at the rear end of the machine and is slidingly mounted on ball bearings, the balls of which run in grooves cut in the top and bottom edges of a supporting plate 433 from which the entire ribbon shifting mechanism is supported by a pair of brackets 434 and 435 each held in place by a pair of screws 436. Supporting bar 433 is detachably connected to one of the round frame members of the machine by screw 440 engaging lug 437 which has a slight possible swinging movement on its supporting bar. There are provided two adjusting screws 438 and 439 (Fig. 52) which can be forced in against the cross bar, after first releasing main screw 440 to swing the entire carriage about the supporting cross member as an axis, thereby adjusting the contact at the platen roller, which has its contact face positioned above the carriage supporting cross member of the frame (Fig. 34).

The carriage includes end plates 441 and 442 and these are connected together by upper and lower bars 443 and 444, each of which is shaped to serve as a ball race for the bearing. At the top, end plates 441 and 442 are connected by shaft 445 carrying adjustable resilient guide fingers 446 and serving as the pivot about which the platen frame may swing. The platen frame comprises end plates 447 and 448 (Figs. 51 and 52), serving as bearings for the shaft of platen 449 and swinging upward about shaft

445 as a center when the platen is to be lifted away from the printing ribbon. These platen end plates also serve as supports for a stationary bar 450 which supports a plurality of spring pressed swinging arms 451 at the lower end of which is cross bar 452 carrying a plurality of short rubber rollers 453 which normally press yieldingly on the paper strip. Rigidly positioned above bar 450 is a paper-cutting knife 454.

Platen Shifting Mechanism.

(Same Figures.)

For rotating the platen forwardly at each stroke of the machine, there is provided ratchet 455 with driving finger 456 actuated from swinging center 457 and held to its work by spring 458. This swinging center is on rock arm 459 which oscillates about a center 460 against the tension of spring 461 and carries at its lower end cross bar 462 which passes across to the other side of the carriage and is there attached to swinging arm 463. Suitable outward movement of cross bar 462 at each operation of the machine, swings plate 459 and so forces ratchet wheel 455 around a proper distance. For producing the periodic outward swing of bar 462 a finger 464 (Fig. 52) is pivoted to swing with rock shaft 465 and carries on its side and pivoted at 466, a supplementary finger 467 which comes into action only when a total is to be taken and when a double space is needed on the paper so that the printed record may conform in appearance with records now common. Rock shaft 465 is slung from suitable brackets 468 and each time the machine turns over, is rotated by forwardly projecting arm 469 which reaches forward into contact with pin 470 carried on swinging plate 372 (Fig. 40), the oscillations of which actuate the ribbon shifting mechanism through swinging block 375 and swinging arm 374 and also through the action of finger 426, shift cam 424 to raise or lower the ribbon. But when

a total is to be taken, auxiliary finger 467 is brought into action by swinging cam plate 471 mounted on sleeve 472 carried by rock shaft 465 and engaging roller 473 carried on auxiliary finger 467. Sleeve 472 can be turned by crank 474 actuated by link 475 which reaches forward (Fig. 40) for rock connection with pin 476 carried on swinging arm 477 pivoted at 478 and actuated by link 479 which extends forward along the base 1 for connection to the total-taking mechanism at rock shaft 26. Thus, when the machine is set to take a total, auxiliary finger 467 will give bar 462 a shift corresponding to one space on the platen and then when the machine turns over to print the total, main finger 464 will be swung in usual manner and in so doing, will swing auxiliary finger 467 outward by still another roller 473 rolling on cam 471, thus giving a double space on the printed record. On restoration of the total-taking mechanism to normal setting, auxiliary finger 467 will be shifted back into its original position by spring link 480 on link 475.

The carriage is shifted on its ball bearings from one side to the other across the machine when the pin 296 (Fig. 52) is swung back and forth by the motor and its clutch connections by link 481 pivoted to sliding block 482 having a pair of spring pressed pawls 483 which can engage with notches in rotatable shaft 484 which crosses the entire width of the carriage and is supported therefrom by depending brackets 485. With the pawls in the notches the oscillatory movements of link 481 will shift the entire carriage forward and back across the machine. By rotating shaft 484, as by turning thumb nut 486 at one end thereof, pawls 483 will slip from their notches and the entire carriage can then be shifted over to bring the pawls into engagement with another pair of notches, thereby changing the range of movement of the carriage and putting the two columns of figures further over on the paper. Accidental rotation of shaft 484 is prevented by swing-

ing arm 486′ carrying a lug for engagement with notches in plate 487 pinned to shaft 484, this arm being maintained in contact with the plate by coiled spring 461 (Fig. 35), (which also pulls down on crank 461′ on shaft 460 to reverse pawl 456 after each stroke thereof) and swinging about a center 488. Also swinging from center 488, is arm 489 (Fig. 51), the upper end of which serves as a retaining finger for arm 490 swinging about a center 491 and rigidly attached to thumb piece 492. This arm 490 governs the position of swinging arm 493 rigidly attached to notched swinging plate 494 pivoted to swing about center 495. This plate swings down against the rear of the stationary supporting plate 433, there to engage with pins 496 (Figs. 34 and 39) to lock the carriage against shifting movement and, to make this lock effective, it is necessary to rotate cross bar 484 far enough to disengage pawls 483 from the notches, thereby freeing block 482 so that it may slide back and forth along the bar without producing movement in the bar.

Supported at the side of arm 493 is finger piece 497 rigidly attached to swinging arm 498 which supports spacing bar 462 so that it is possible for the operator to reach across over the machine and by hand shift the platen, notch by notch, as may be desired. The return movements of the spacing bar, whether it is being operated by hand or by the swinging fingers, are effected by coiled spring 499.

Supported immediately below the platen is plate 500 (Fig. 35), which is suspended from end plates 501 (Fig. 37), one of which is connected through link 502 to a part of the carriage frame slightly off center with respect to the axis 445 about which the platen swings, so that as the platen is swung up to expose the entries last printed, plate 500 is shifted around by its toggle to bring its upper edge just below the printed entry, there to serve as a guide or ruler extending the entire width of the paper sheet.

Thus no spacing stroke need be taken before making a total, for the total can be taken immediately after any item is in.

Supporting Stand.

(Figs. 48 and 50.)

The stand whereon the machine is mounted for commercial use comprises four angle iron legs 503 held together at their lower ends by connecting bars 504 and suitably cross braced from similar members 505 at the top. Enclosed within each leg is round post 506 carrying caster 507. The upper ends of these posts are connected rigidly together by cross bars 508 and these posts can be shifted with respect to the frame so that the stand is carried either on casters 507 or on rigid feet 509 positioned one at each corner of the base. This shifting mechanism comprises short toggles 510 pivoted to bell cranks 511 connected together in pairs by cross bars 512, two of the bell cranks being rigidly connected to rock shaft 513 provided with swinging arms 514 extending downward and connected by handle bar 515. With the handle bar down against the legs of the frame (Fig. 50), the bell crank will be in released position and the weight of the machine and its supporting stand will be carried by feet 509. If, however, the stand is to be moved about the room, the operator in taking hold of handle 515 and pulling up on it to drag the machine about the room, will lift the frame with respect to posts 506 and so will lift the weight from feet 509 and transfer it to casters 507. After the machine has been moved, the release of the handle will immediately drop it onto feet 509.

Motor Control.

This includes treadle 516 supported from cross shaft 517 at the rear side of the frame and serving to pull down on chain 518 which leads to a motor controlling switch which is so constructed that when the operator steps on the treadle the motor switch

closes instantly and the motor starts, but when the operator releases that treadle to open the motor switch, the opening does not take place immediately, but is delayed for a brief interval of time, say a half minute. This delay permits the operator to leave the machine for a moment and he will find the motor running when he returns, but if he stays away for any considerable time, the switch will act to open the motor circuit and stop the rotation of the motor. This mode of control gives the operator freedom of both hands.

The Duplicator Mechanism.

(Figs. 8, 10, 17, 53 to 57.)

This is for taking any number set up on the keyboard and storing this number for future redelivery to the machine. This is preferably termed a duplicator mechanism. It comprises an automatic memorandum whereby the operator may "carry" any number which he has once set up on the keyboard and may then by shifting a single control, at any time, redeliver this number to the machine for any operation of which the machine is capable, precisely as if he had again set up the number on the keyboard.

In the side frames of the machine in front of accumulator pinion 63 and aligned radially with shaft 69 carrying the racks and stop-noses, are four studs, two in each side of the machine, one of each pair being shown at 520 and 521 (Fig. 54). Stud 520 is seated in washer 522 secured by screw 523 threaded into stud 520. The corresponding pins 521 are similarly mounted. Studs 520 and 521 have apertures therein radially aligned with shaft 69 in which are rigidly mounted rods 524 and 525 on which is slidably mounted a table structure comprising a pair of arches 526, 526′ (Figs. 54 and 57). Arch 526 is sleeved by means of sleeves 527 and 528 upon rod 524 and arch 526′ is similarly sleeved upon rod 525 by sleeves 527′ and 528′. Bridged across the tops of these

arches and secured thereto by screws 529′ (Fig. 17), is plate 529 having a pair of brackets 530 and 530′ in which is mounted duplicator shaft 531, having revolubly mounted thereon associated pairs of duplicator numeral wheels 532 and duplicator pinions 533, this structure being the same as that of the associated numeral wheels 64 and accumulator pinions 63. These duplicator numeral wheels are marked D_1 to D_9 in Fig. 1. Each duplicator pinion 533 has rigidly fastened thereto plate 534 having formed thereon stop tooth 535 (Figs. 54 and 17) adapted to co-operate with stop teeth 536 depending from plate 529 to stop each duplicator numeral wheel at its zero position. The duplicator pinions 533 are aligned with the toothed stop-nose arms 70.

Revolubly mounted in the two side frames is shaft 537 carrying rigidly mounted thereon cranks 538 which in turn carry pitmen 539 pivotally connected at their lower ends with shaft 531 upon which are mounted the duplicator pinions and duplicator numeral wheels. Bridged across the side frames of the machine is bar 540 (Fig. 17), to which is secured by screws 541 angle bar 542, the angled portion 543 of which serves as a retaining tooth to prevent accidental rotation of the duplicator pinions when the latter are out of mesh with the stop-noses 70, the function of this tooth 543 being precisely the same as that of the tooth 67. Thus, a partial rotation of shaft 537 will serve to slide shaft 531 radially toward or away from stop-noses 70, causing pinions 533 to mesh with stop-noses 70 or to be locked by tooth 543.

Referring to the mechanism for throwing the duplicator pinions into or out of mesh with stop arms 70 (Fig. 53): Rigidly mounted upon shaft 537 is an irregularly shaped plate 545 having thereupon tooth 546 and lug 547. Rotatably mounted upon stud 548 in the side frame of the machine is plate 549, arc-shaped at its upper and lower edges. This plate has in its lower edge three notches 549*a*, 549*b*, 549*c*, adapted to be engaged by tooth 550 on

bell crank 551 mounted on stub shaft 552 and normally held in engagement with a notch by spring 553 whose opposite end is anchored in stud 554 mounted in the machine frame. Upon plate 549 are studs 555 and 556, which form guides for release plate 557 slidably mounted on the studs by slots 558, 559. Plate 557 is normally held up by spring 560 anchored at its other end to plate 549 but may be depressed by knurled knob 561, which is marked DL to indicate "Duplicator Lever." The lower end of plate 557 is arc-shaped to conform with the lower edge of plate 549, except that it is smooth. Thus, when knob 561 is depressed, the lower edge 562 of plate 557 will disengage tooth 550 from whichever notch it is in and allow plate 549 to be rocked either to the right or left. The plate 549 can thus be positionel and locked with tooth 550 in engagement with any one of the three notches. Plate 549 is restrained from excessive movement in either direction by stud 563 co-operating with arc-shaped slot 564 therein.

Plate 549 has projecting therefrom two lugs 565 and 566 (Figs. 53 and 56). Pivotally mounted upon stud 548 is rocking plate 567 having ears 568 and 569 thereon radially less distant from shaft 548 than are lugs 565 and 566, so that these lugs and ears may pass each other. Plate 567 is connected at its upper end with plate 545 by link 570. Loosely mounted upon stud 548 are two plates 571 and 572 having fingers 573 and 574 respectively thereon, which fingers are adapted to engage with the pairs of lugs 565 and 568, 566 and 569 respectively. Plates 571 and 572 are anchored by springs 575 and 576 to eyes 577 and 578 upon the repeater control. Pivotally connected with plate 549 is link 579 which is expanded at its upper end to provide broad notch 580, co-operating with lug 547, and slot 581. Rotatably mounted upon stud 580′ in the side frame of the machine is a bell crank comprising arm 582 having thereon roller 583 projecting into slot

581 and arm 584 which is bent outwardly at 585 and co-operates with roller 586 upon disk 587 upon the extreme end of main rock-shaft 155. Bell crank 582-584 is normally held to the right (Fig. 53) by spring 588, whose other end is anchored to stud 589 in the machine frame. Shaft 174 (which withdraws the zero pins) is connected by crank 590 with depending arm 591 having a slot and pin connection 592-593 with plate 549. Thus, when plate 549 is swung to the left or in a counter-clockwise direction, shaft 174 will not be disturbed. When plate 549, however, is swung to the right, shaft 174 will be rocked and the zero pins withdrawn.

In operation, when it is desired to roll a number into the duplicator pinions, plate 549 is swung forward. In this position, link 579 will be moved rearwardly until rear end 580a of notch 580 engages lug 547, thus positively holding plate 545 as in Fig. 53, wherein the numeral pinions are out of mesh with stop-noses 70. In this position lug 565 will be moved to the left and finger 573 under the impulse of spring 575 will tend to rock plate 567 in a counter-clockwise direction and thus through the intermediary of link 570 rock plate 545 and throw the numeral pinions into mesh; this action, however, being prevented by the positive engagement just noted between lug 547 and rear end 580*a* of notch 580. When the machine turns over, however, at the end of the forward stroke roller 586 will engage arm 584 of bell crank 584-582, thus through the intermediary of roller 583, depressing link 579 and releasing lug 547, whereupon duplicator pinions 533 will snap into mesh with the stop-nose arms and remain in mesh therewith during the rearward stroke thereof, thus rolling into the duplicator pinions whatever number had been set up upon the keyboard. Having thus stored the number in the duplicator pinions, the operator resets plate 549 to a central position, whereupon, since springs 575 and 576 are equal in strength, the parts return to the normal position in Fig. 53. The machine may now

be operated for an indefinite period until such time as it is desired to reproduce the number stored in the duplicator pinions. When this is desired plate 549 is set to the right, whereupon link 579 is pulled rearwardly and until forward end 580*b* of the notch 580 impinges upon lug 547 and positively swings the duplicator pinions into mesh with the stop-nose arms before the turnover of the machine. In this position lug 566 being swung to the left, finger 574 would tend, under the influence of spring 576 to swing plate 567 in a clockwise direction and thus snap the numeral pinions out of mesh. This action, however, is prevented by the engagement of the forward end 580*b* of notch 580 with lug 547. At the end of the forward stroke, however, roller 586 trips lever 584 releasing lug 547, whereupon the duplicator pinions are snapped out of mesh with the stop-nose arms. Before the turnover of the machine, rock-shaft 174 has been rocked to withdraw the zero stops by link 591 and crank 590, leaving the stop-noses free to swing forward, thus since the duplicator pinions are in mesh at the beginning of and throughout the forward stroke of the machine, each of these pinions will be rotated by the stop-nose with which it is engaged until its stop 535 engages with stationary stop 536, thus setting its corresponding duplicator numeral wheel to the zero position and allowing the corresponding stop-nose arm to swing to a position corresponding to whatever number was indicated by the duplicator numeral wheel. Thus the duplicator pinions act as a substitute for the keyboard and the accumulating part of the machine is set up through them precisely as if the keyboard had been fingered.

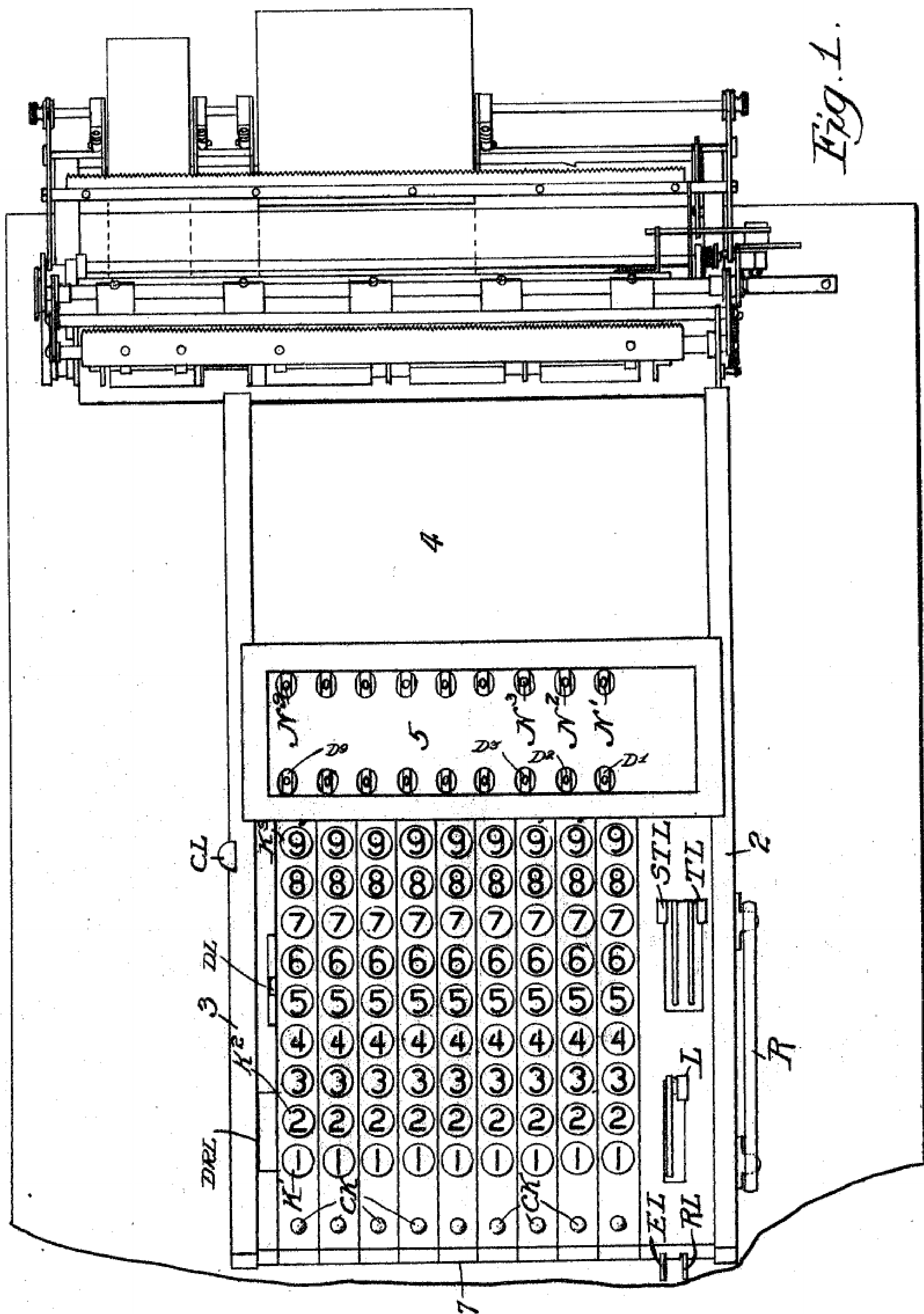
It is sometimes desirable to retain the number in the duplicator after it has been delivered to the machine, as for instance when the same number is to be repeatedly used throughout the course of calculation upon which the operator is engaged. For this purpose there is provided a repeat control 595, marked DRL

to indicate "Duplicate Repeat Lever," pivoted on shaft 596 in the machine frame. Repeat control 595 is arc-shaped and knurled as shown, and has pivotally connected therewith link 596′, which at its other end is pivotally connected with dog 597 rotatably mounted upon the stud 580′. Upon delivering to the machine, the duplicator pinions go into mesh before the beginning of the forward stroke. When it is desired to retain the number in the duplicator pinions, repeat control 595 is rocked backward, whereupon disk 597 slips under tooth 546 and prevents the pinions from snapping out of mesh at the end of the forward stroke and the number is rolled back into these pinions on the back stroke of the machine. After the operation of the machine, the repeat control is set back to its normal position, plate 549 is also set back to normal position whereupon the duplicator pinions move out of mesh with the number just delivered to the machine still retained therein.

During the shift of these controls the machine is locked precisely as it is locked during the shift of any other control. The mechanism therefor comprises link 598 having forked end 599 engaging with pin 600 on arm 601 rigid with shaft 206 carrying arms 602 connected to rod 62′. When push button 561 is depressed, rod 62′ will be lowered, thus rocking plate 205 and locking the machine. For locking the machine during the shifting of the repeat control 595, the lower end of this control is provided with a cam projection 602 which co-operates with a cam roller upon arm 603 pivoted upon stud 604 mounted in the machine frame and normally held by spring 605 whose other end is anchored to stud 606 in the machine frame. Arm 603 carries depending projection upon which is mounted a roller engaging with wing projection 608 from arm 601. Thus, while repeat control 595 is moving from one position to the other, rod 62′ is rolled and the machine locked against movement.

NEXT ITEM

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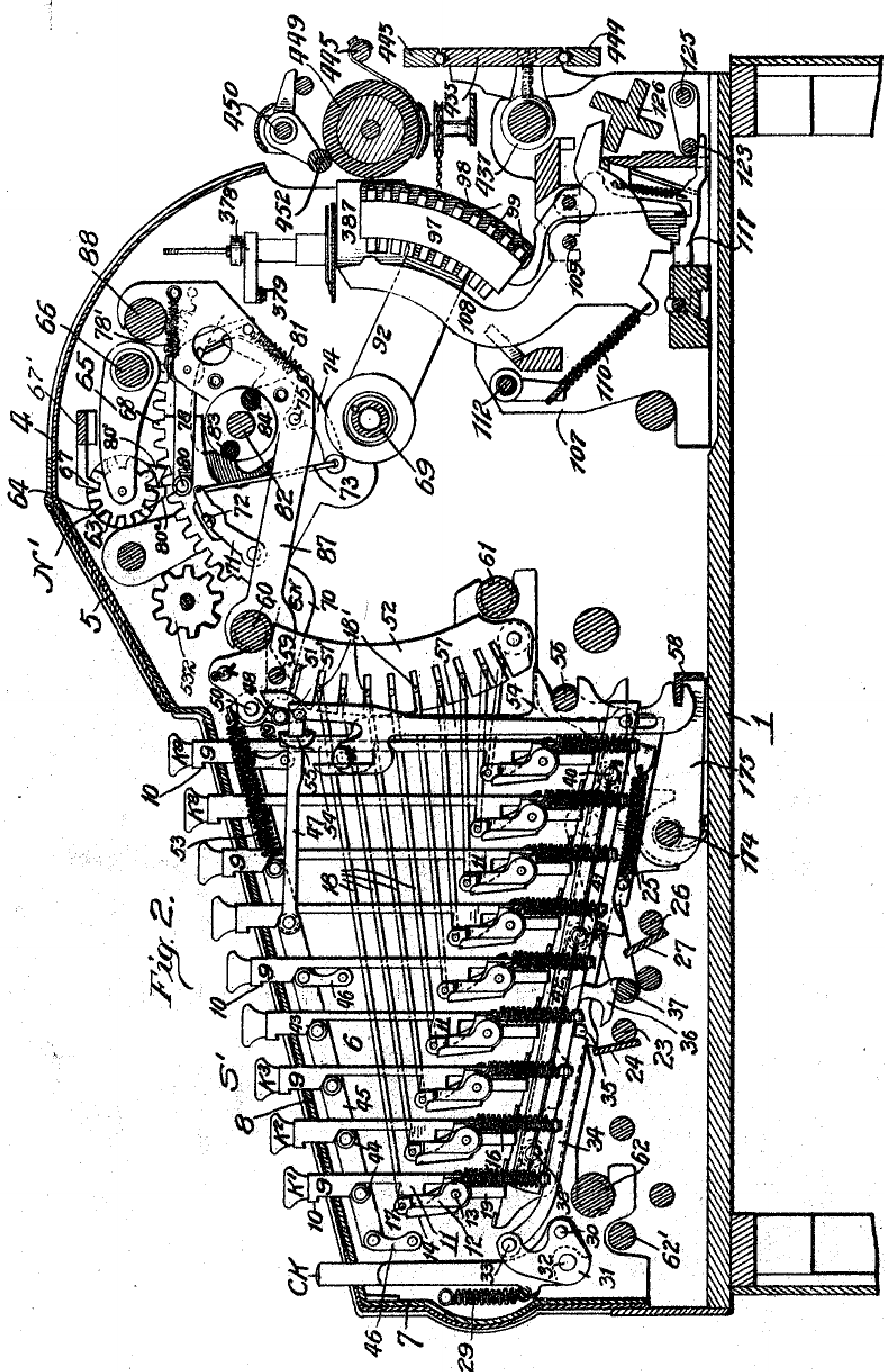
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Martin Teetor
by Wallace R. Lane
Atty.

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Merrill M. Blackburn

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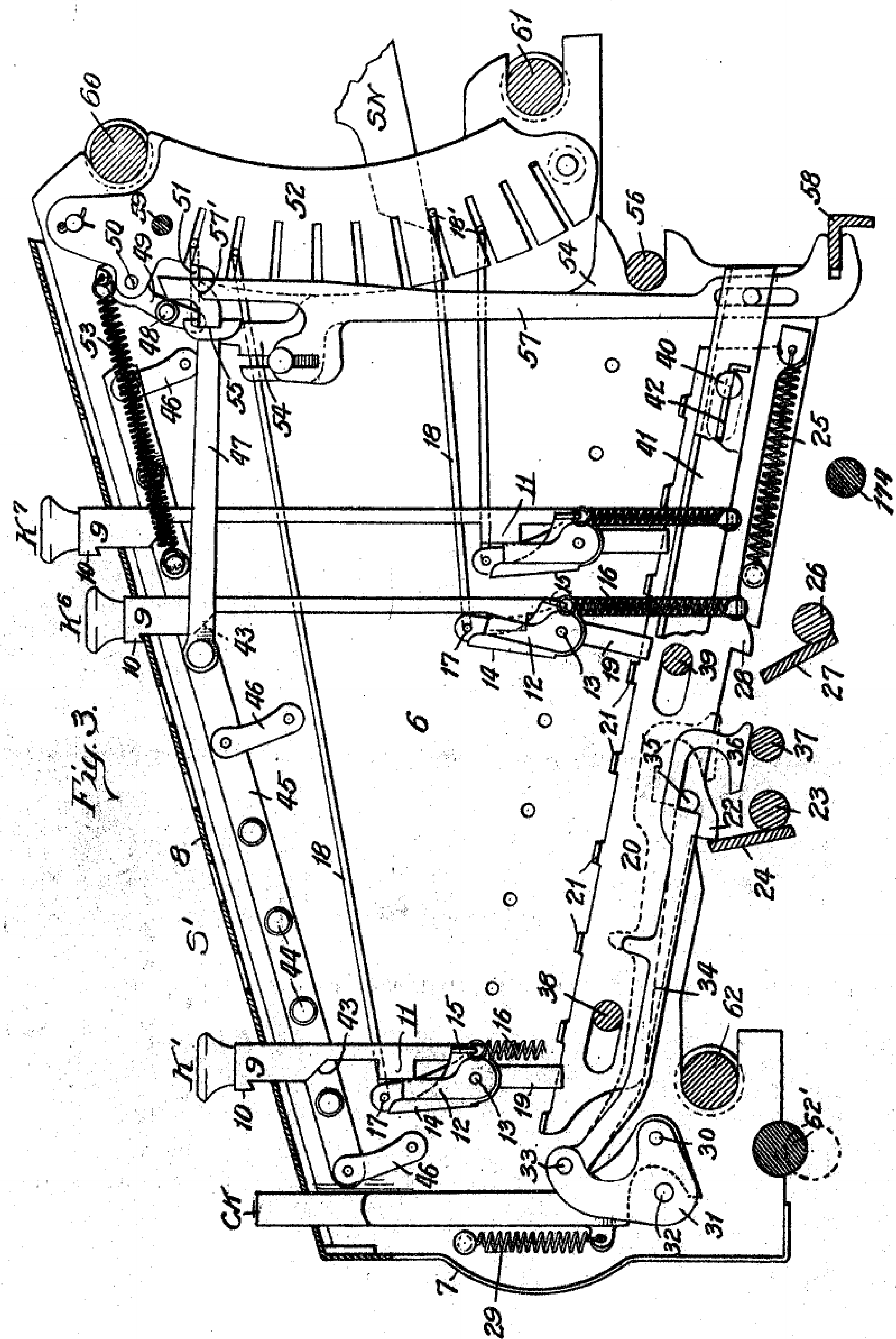
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Merrill M. Blackburn

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by Wallace R. Lane
Atty.

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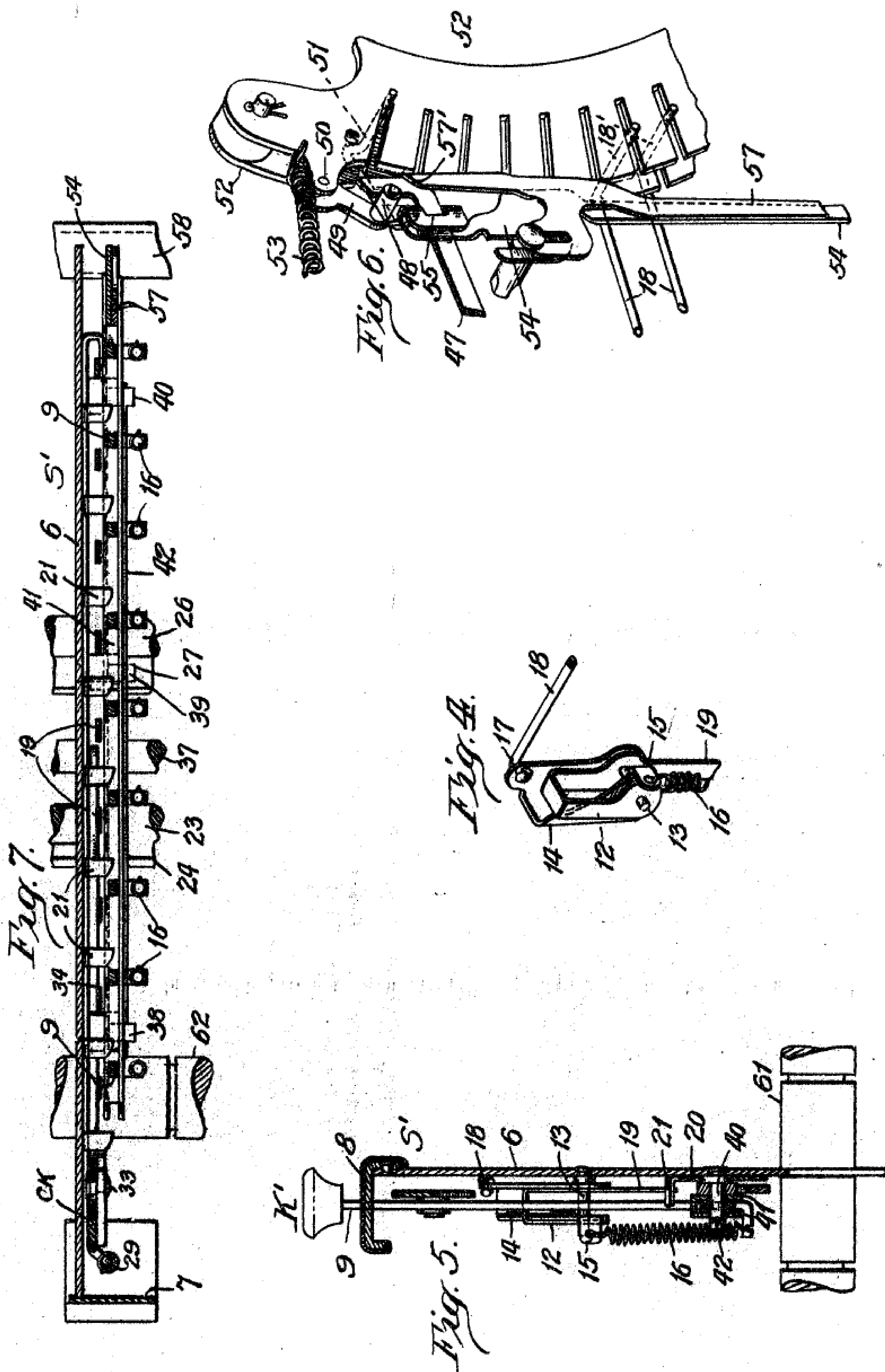
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Merrill M. Blackburn

Inventor:
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by Wallace R. Lane,
Atty.

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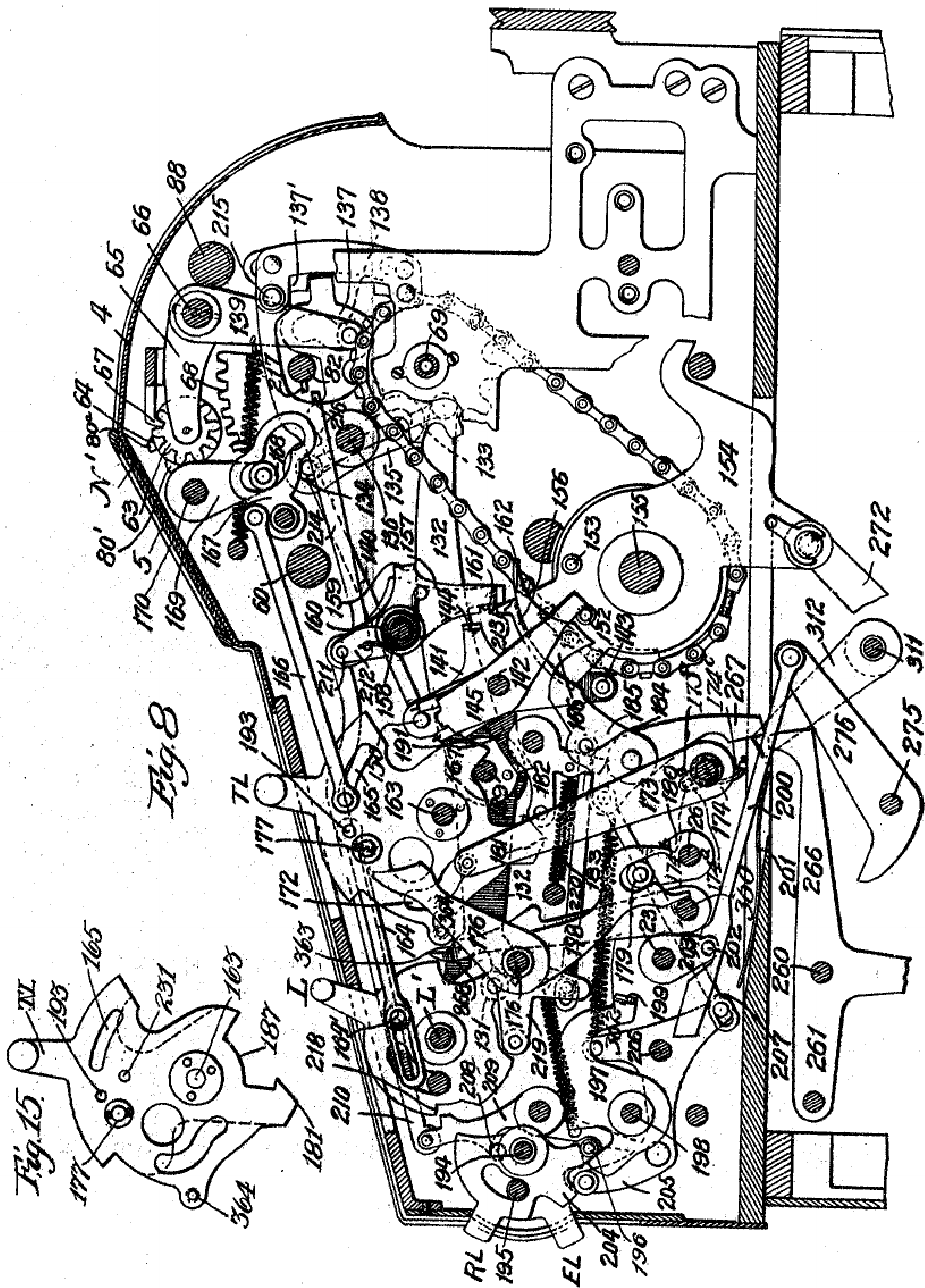
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by Wallace R. Lane
Atty.

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Merrill M. Blackburn.

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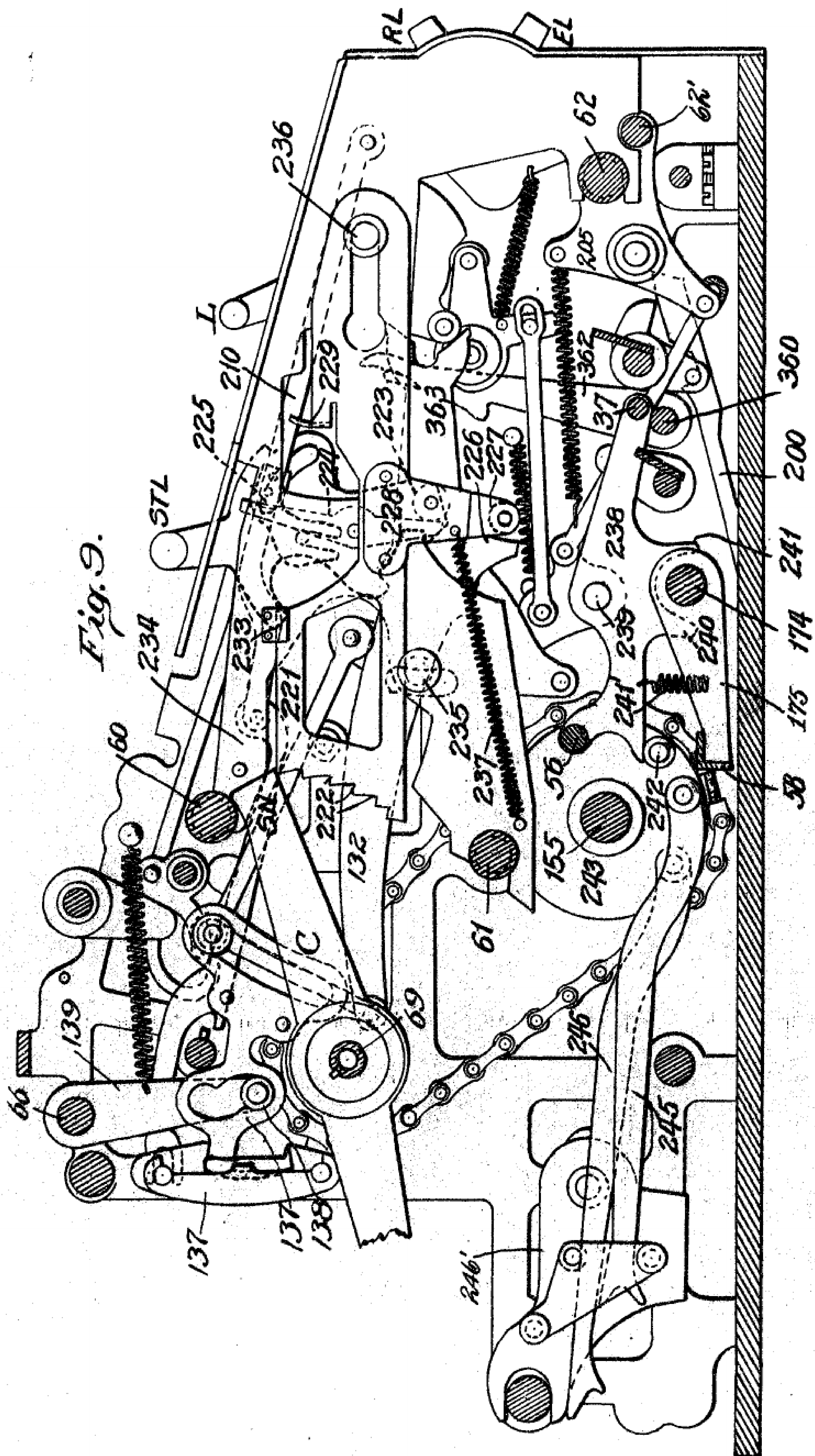
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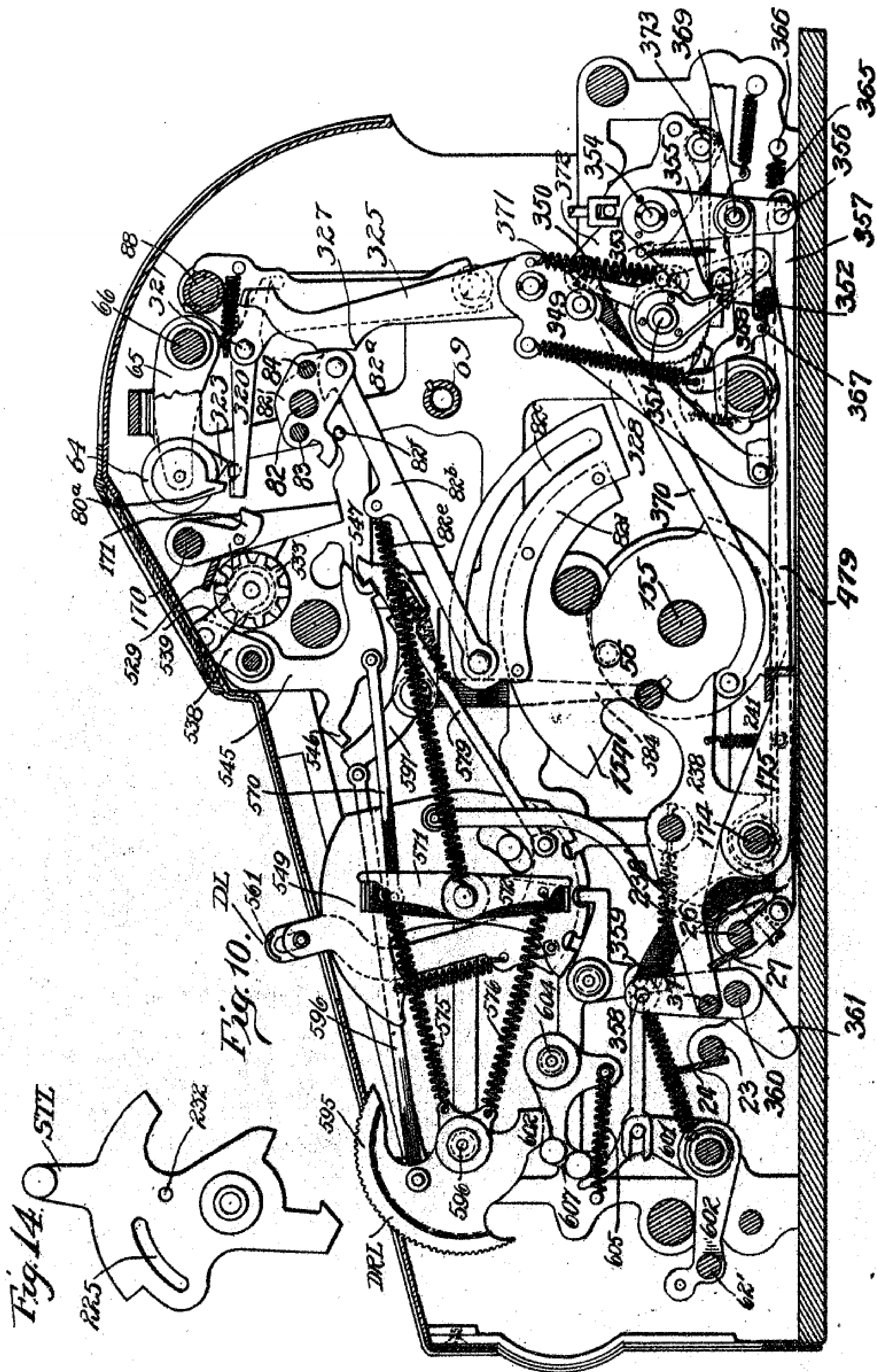
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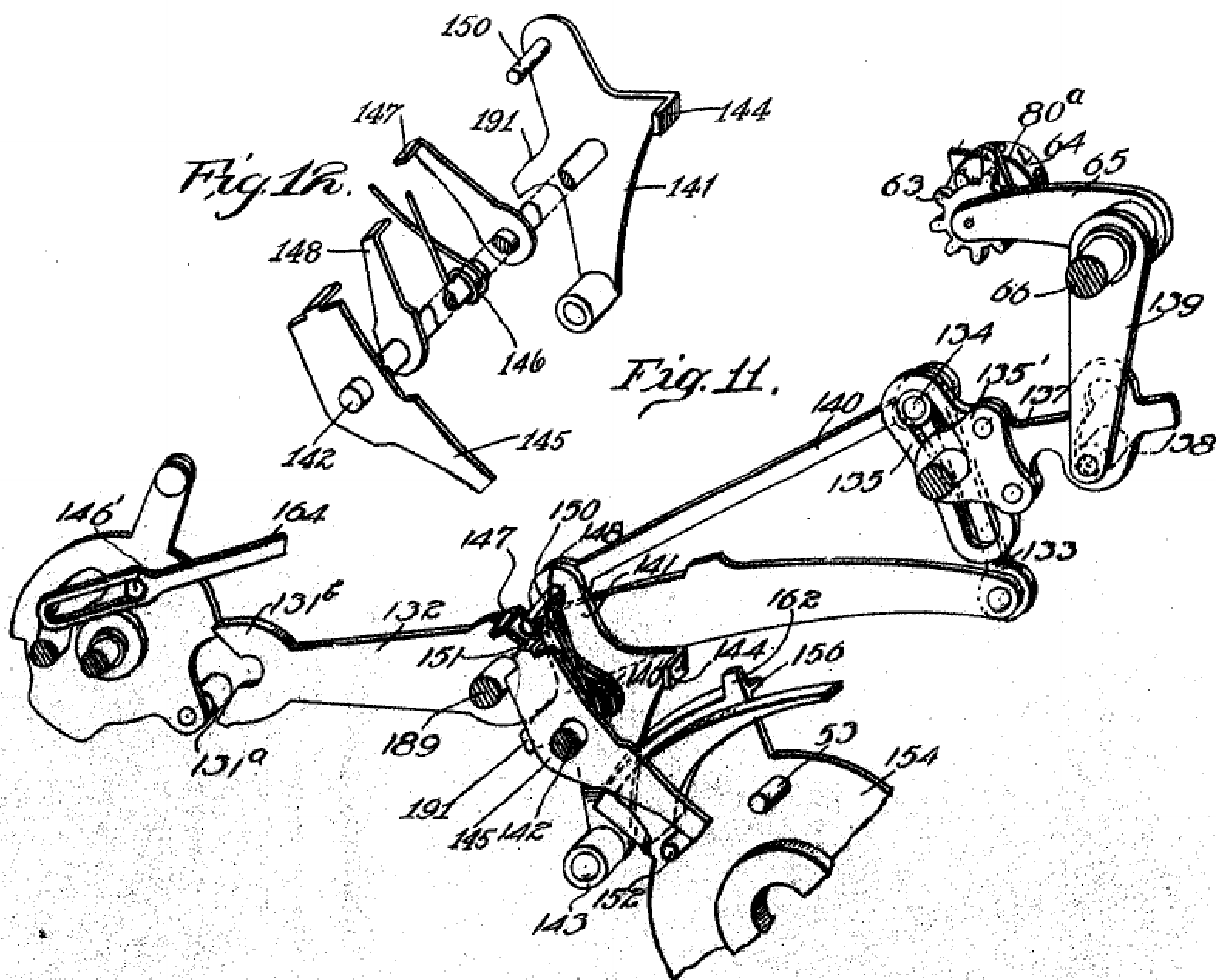
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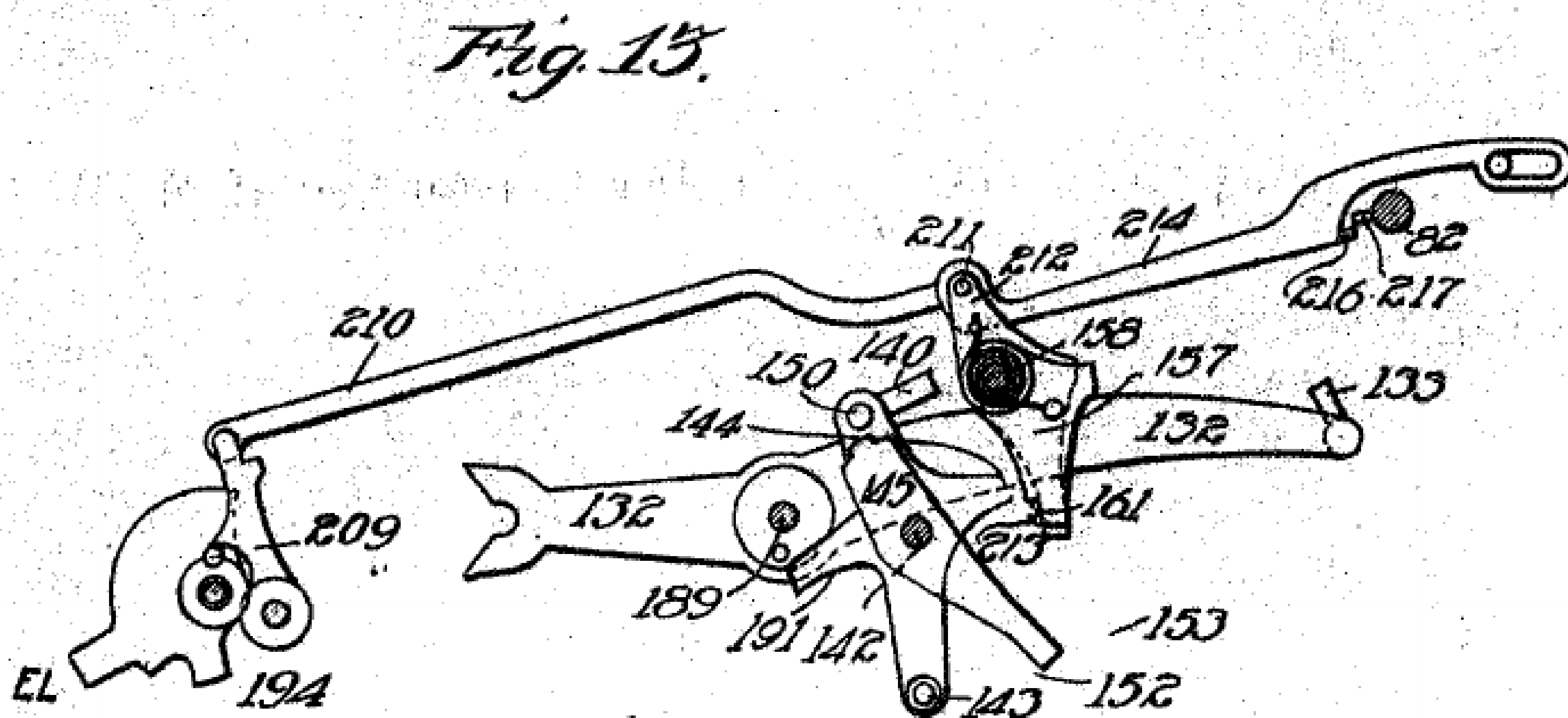
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Merrill M. Blackburn

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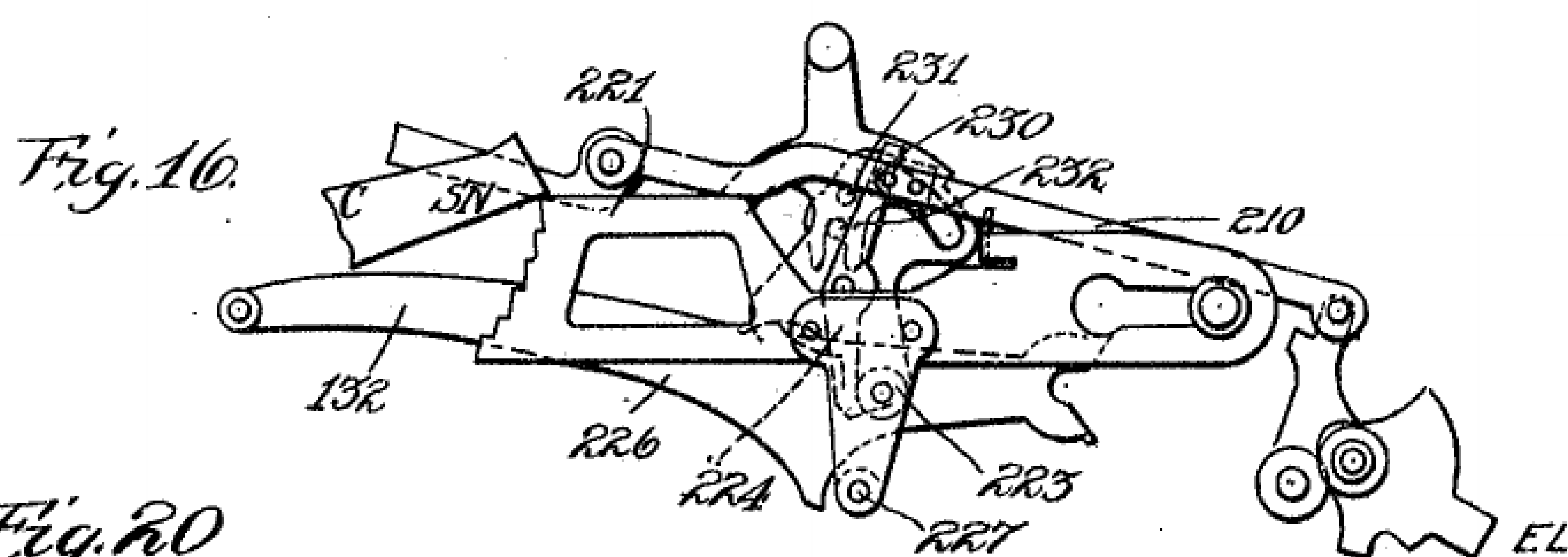
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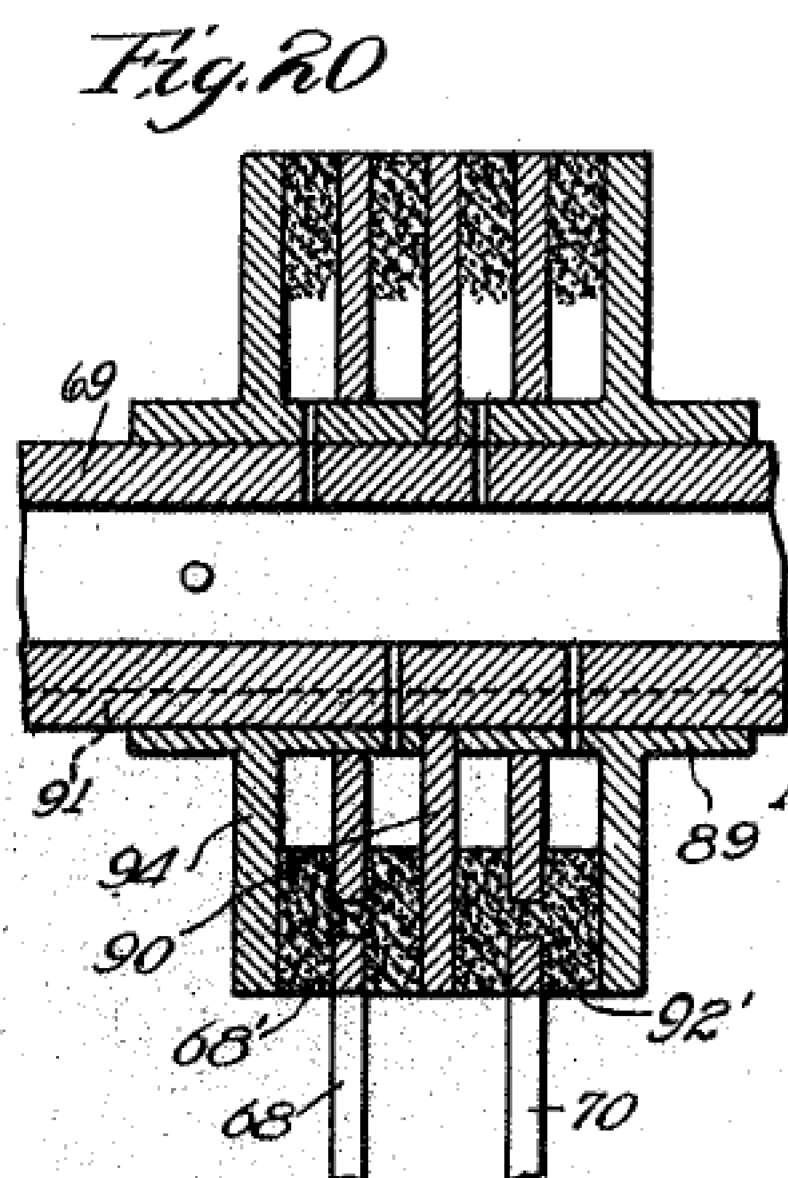
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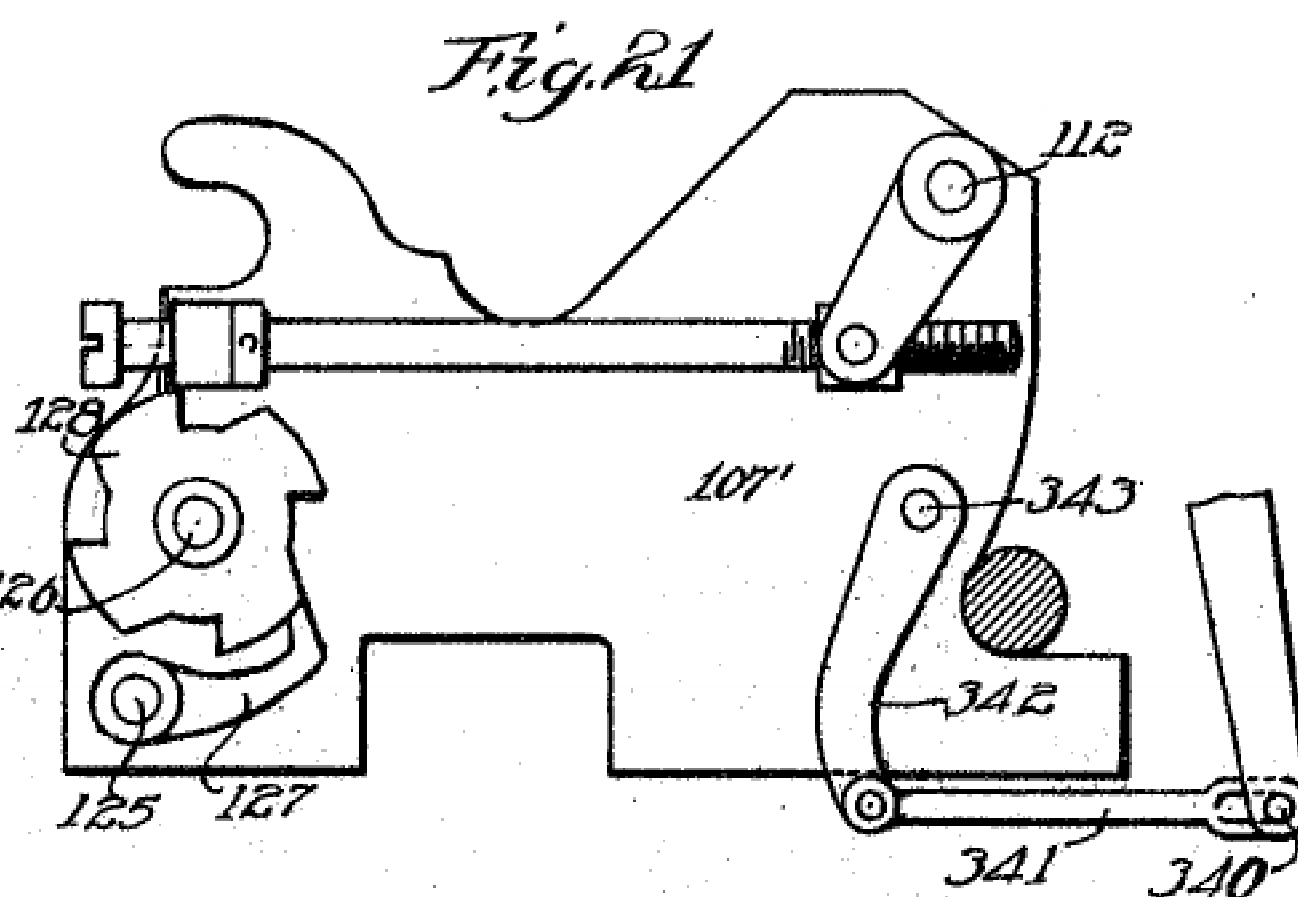
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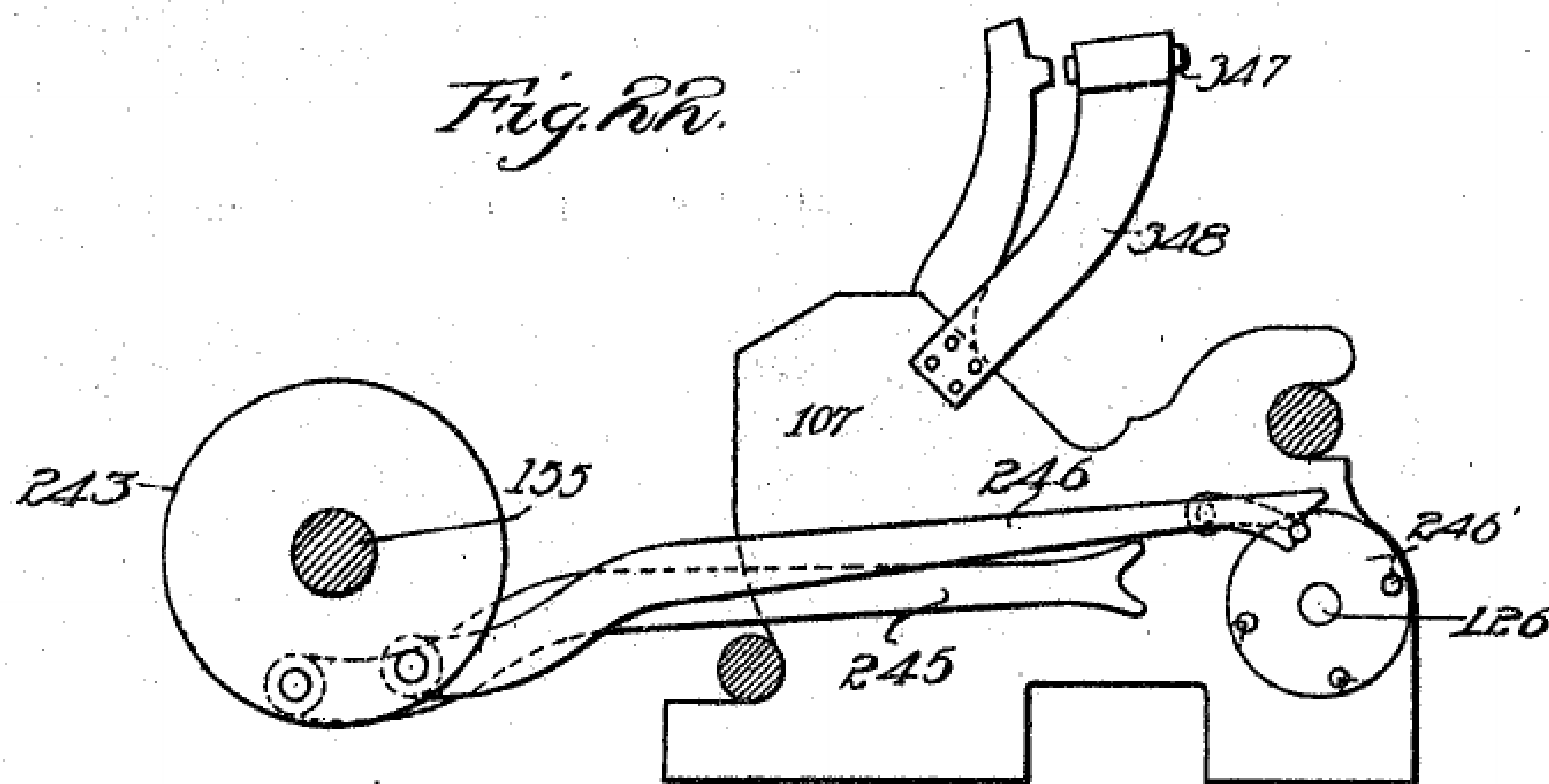
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Merrill M. Blackburn

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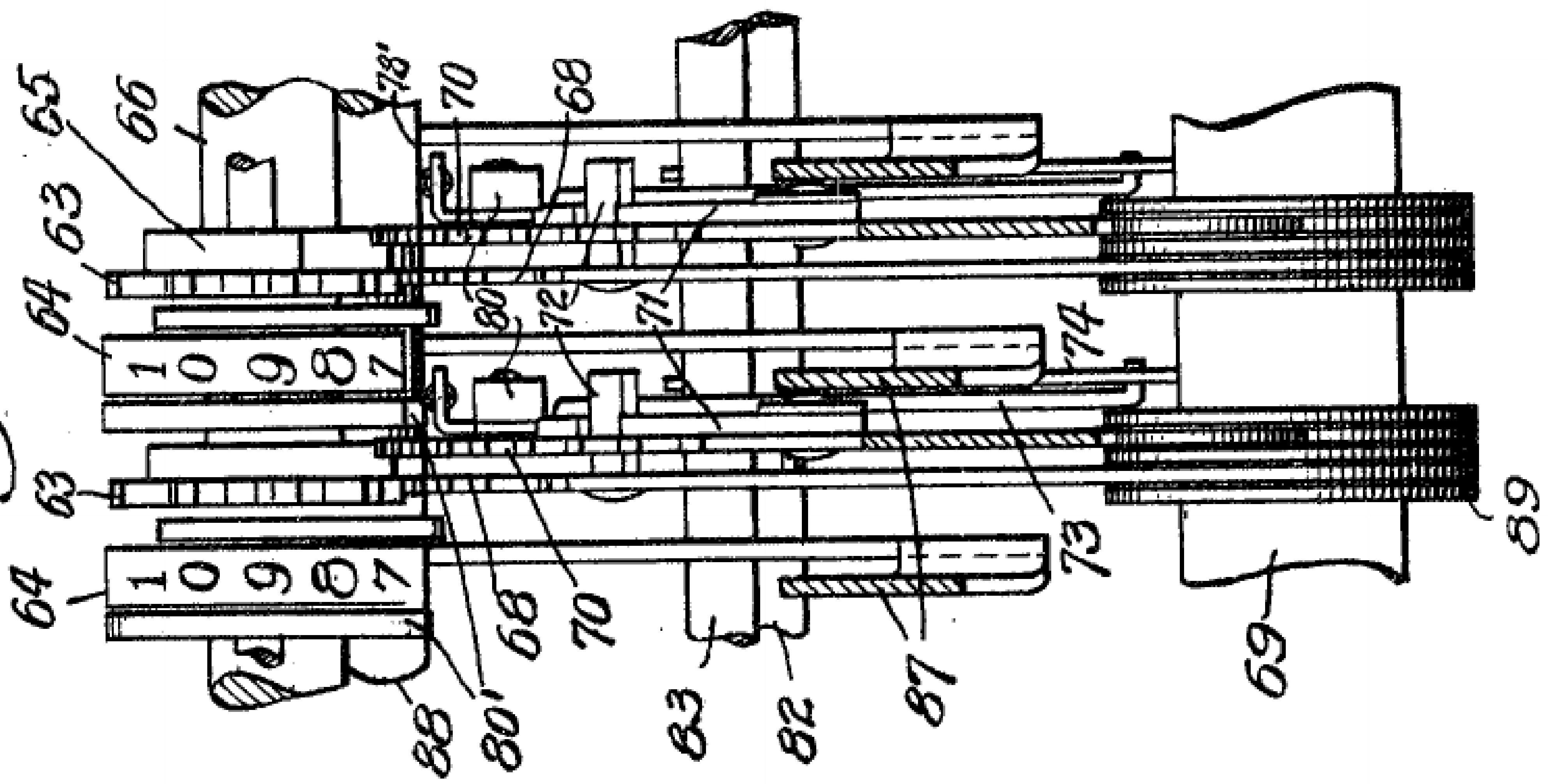


Fig. 18.

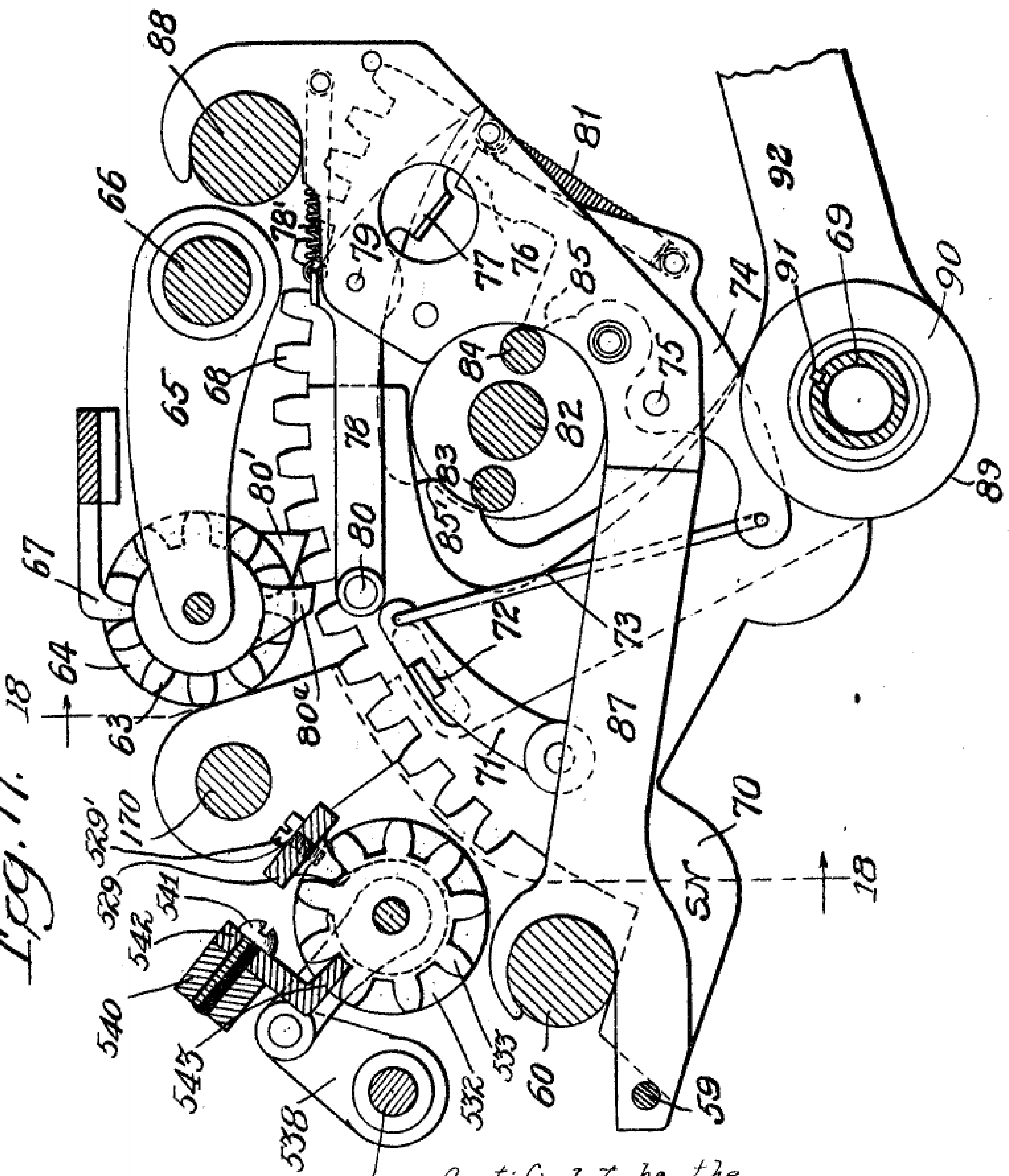


Fig. 17.

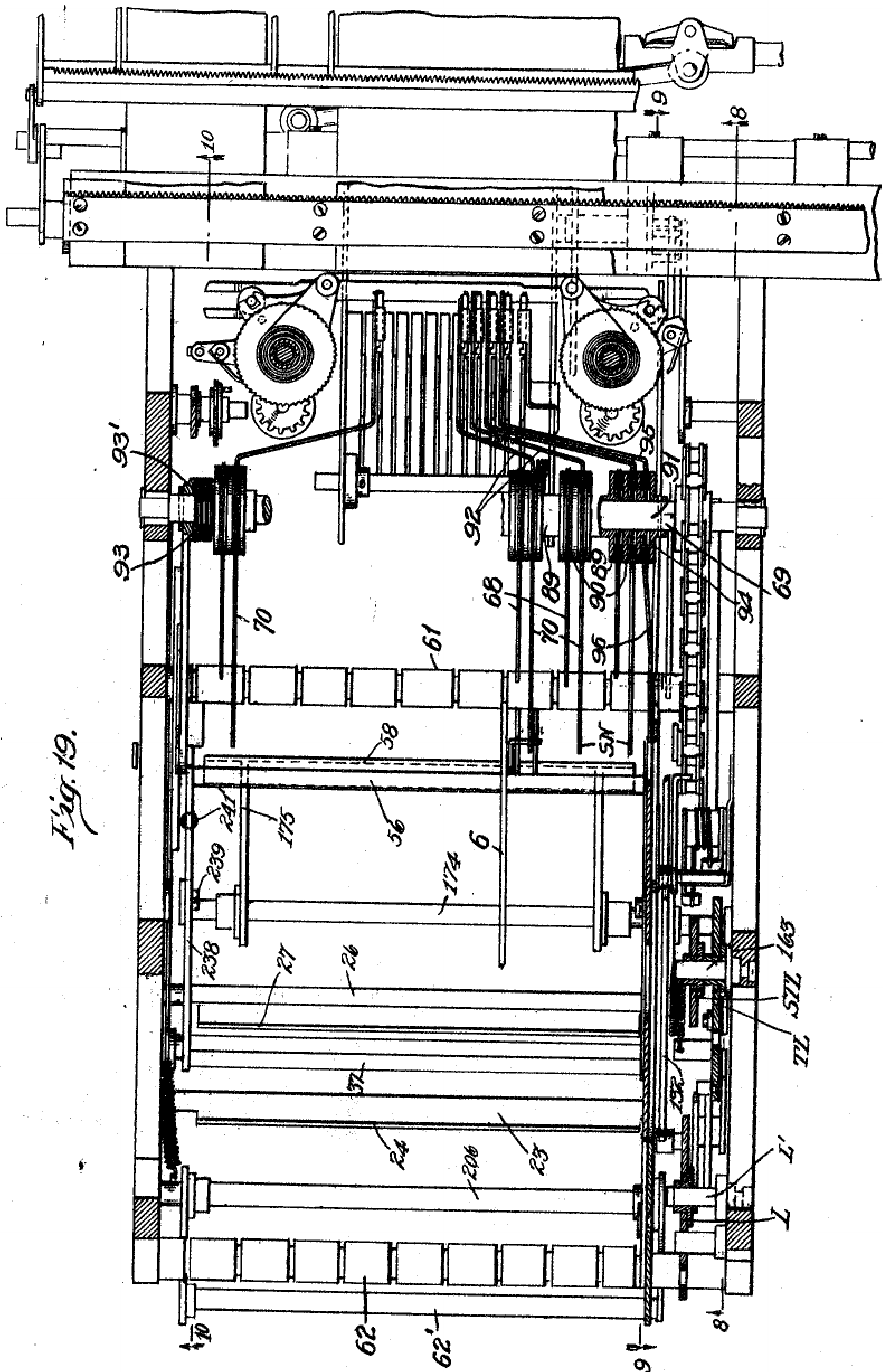
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by Wallace R. Lane
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Merrill M. Blackburn

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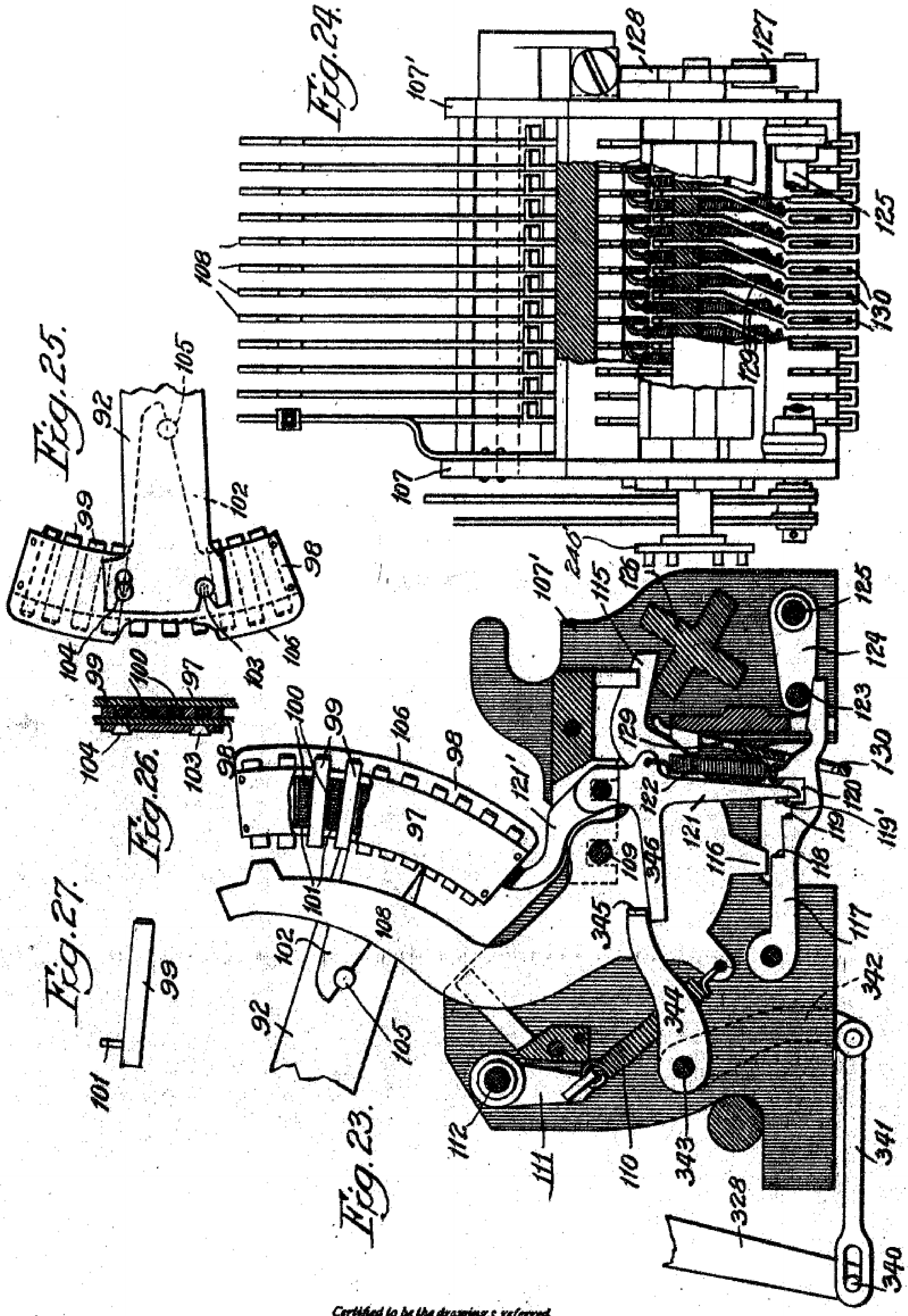


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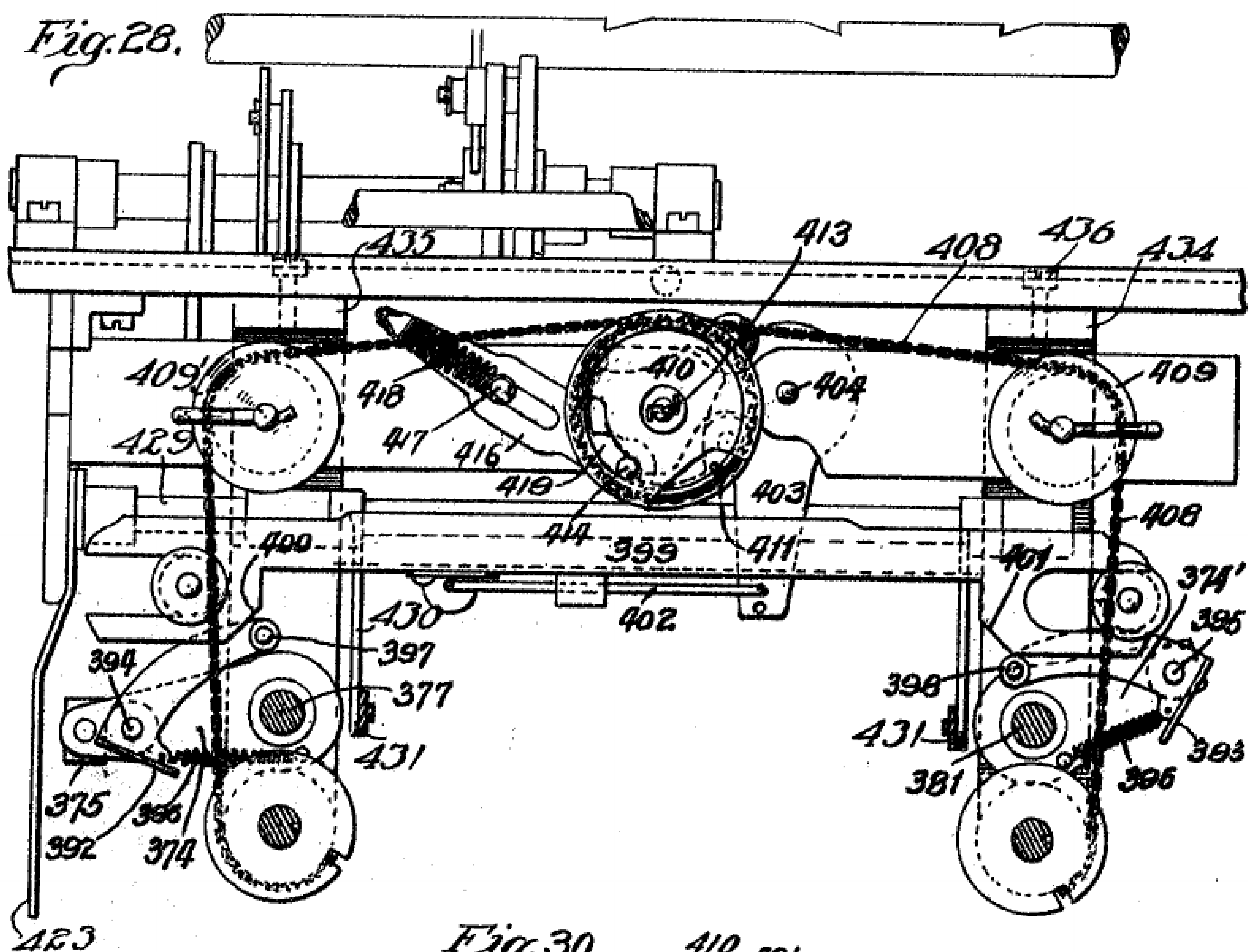


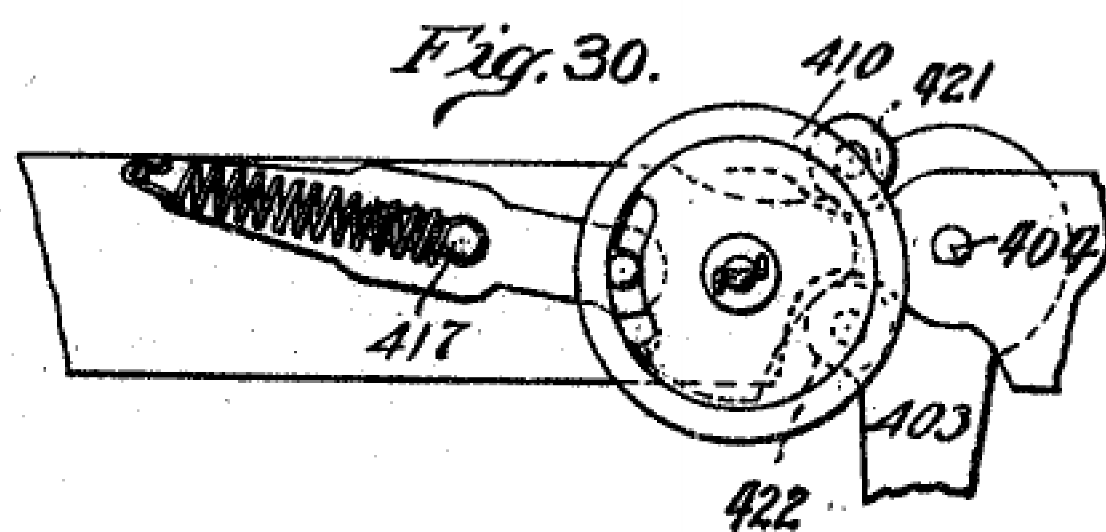
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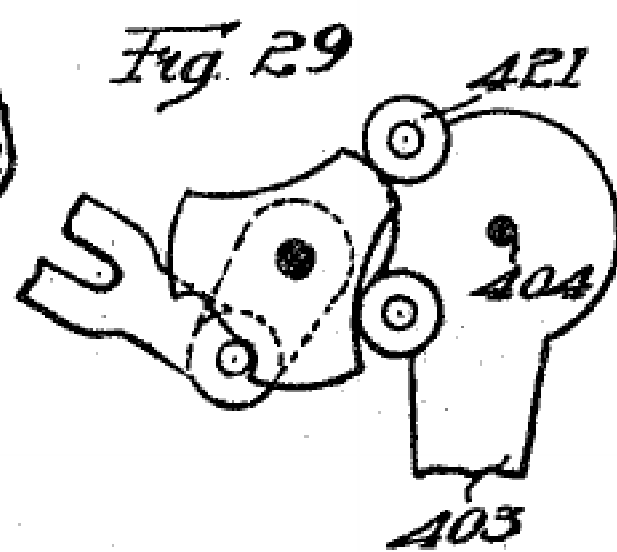
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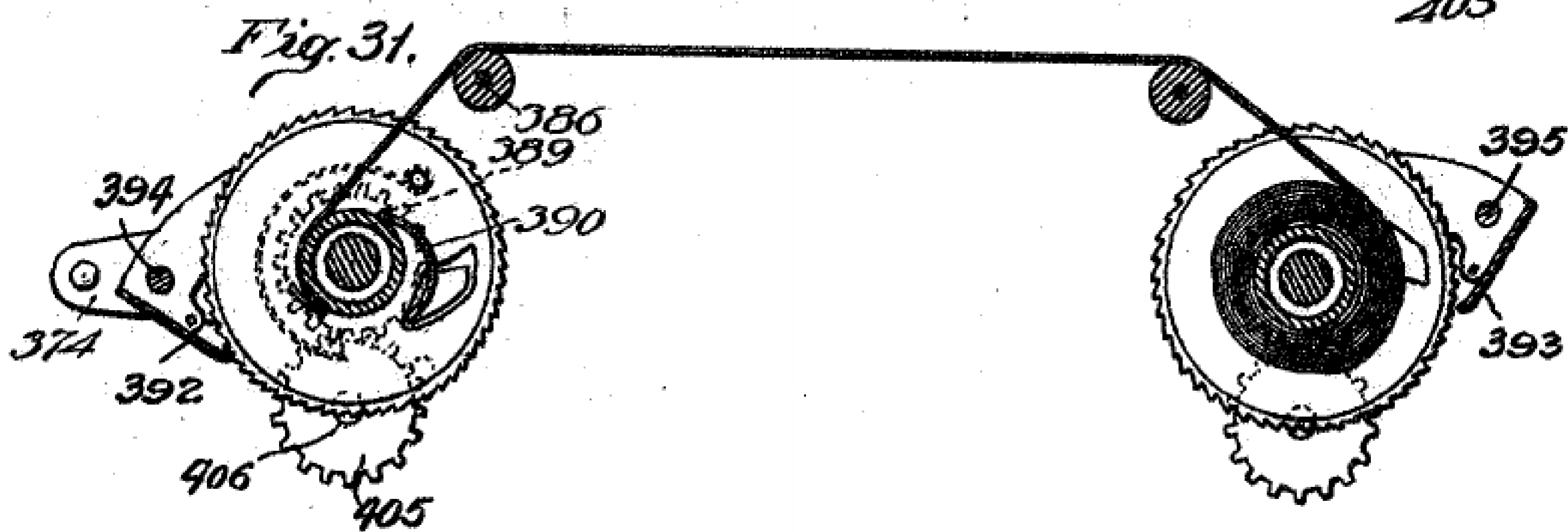
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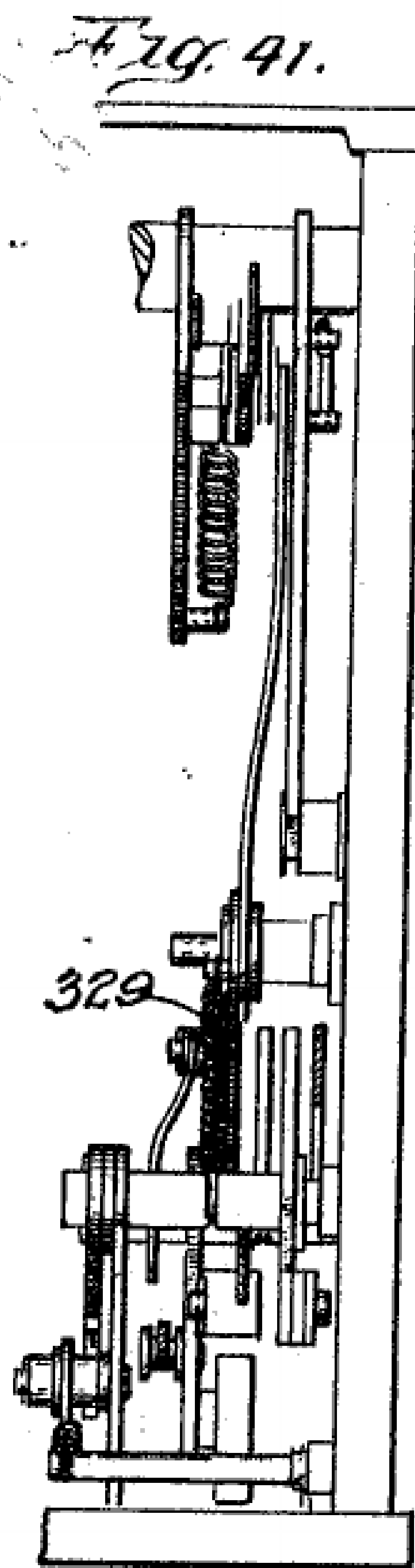
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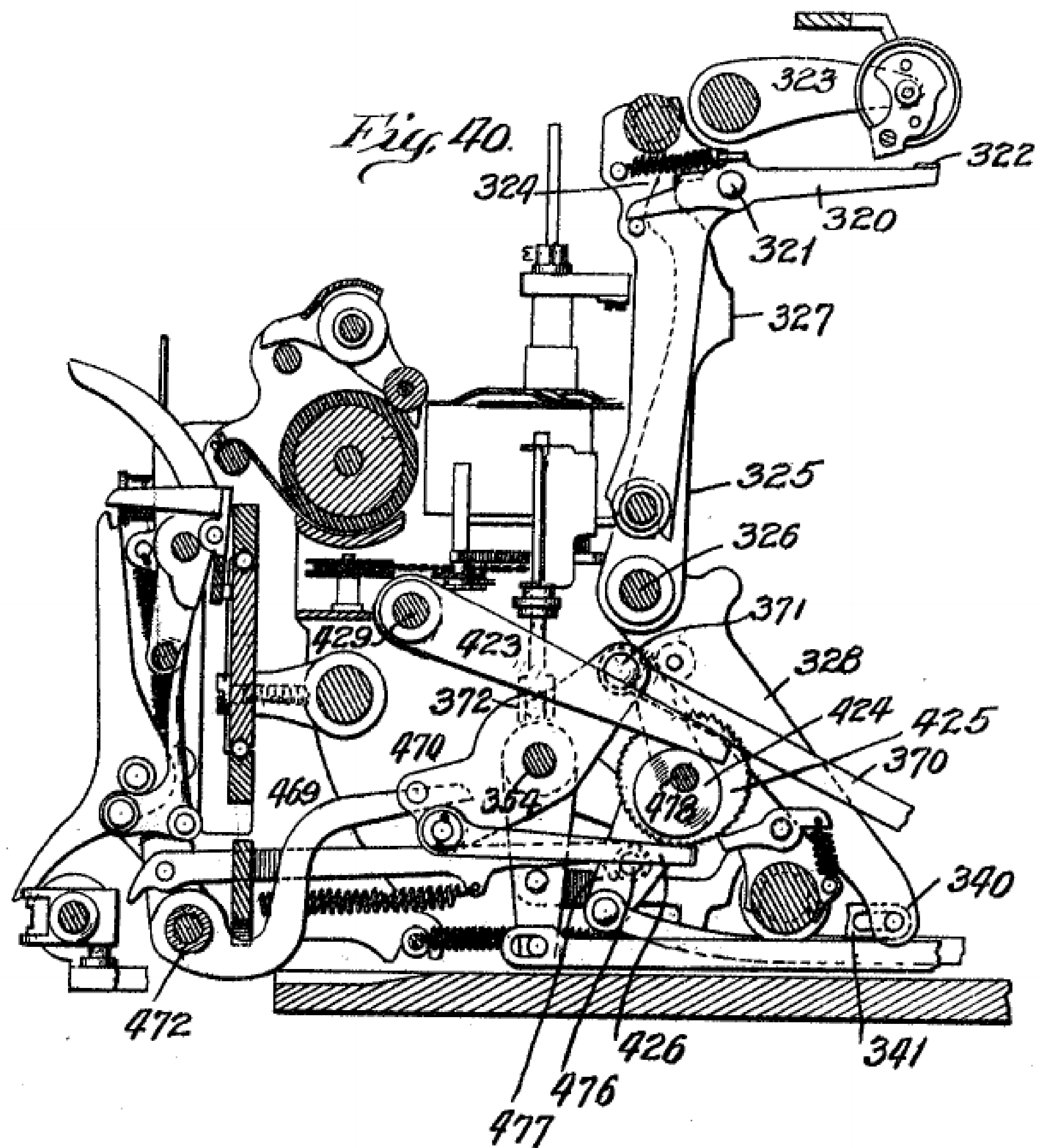
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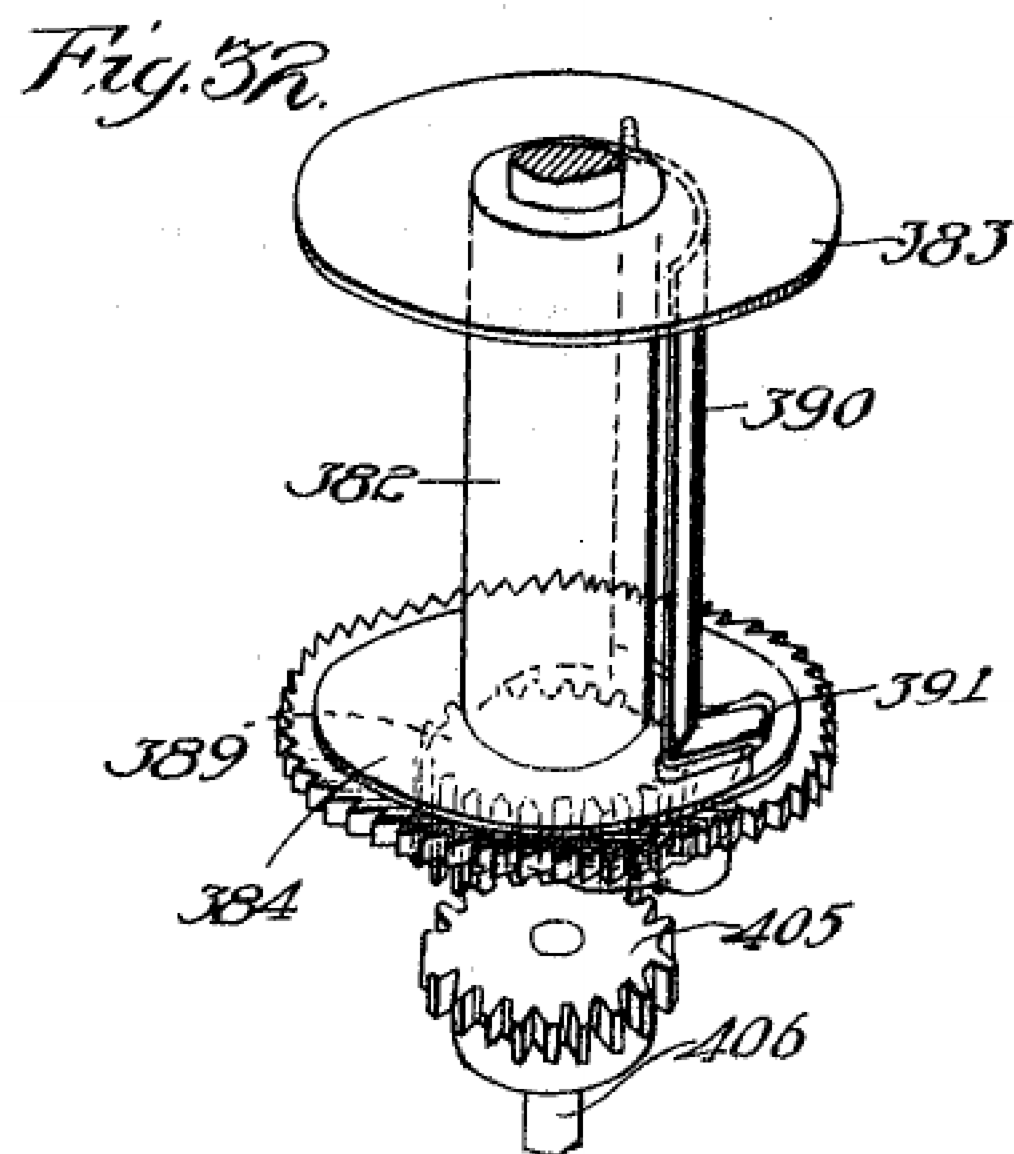
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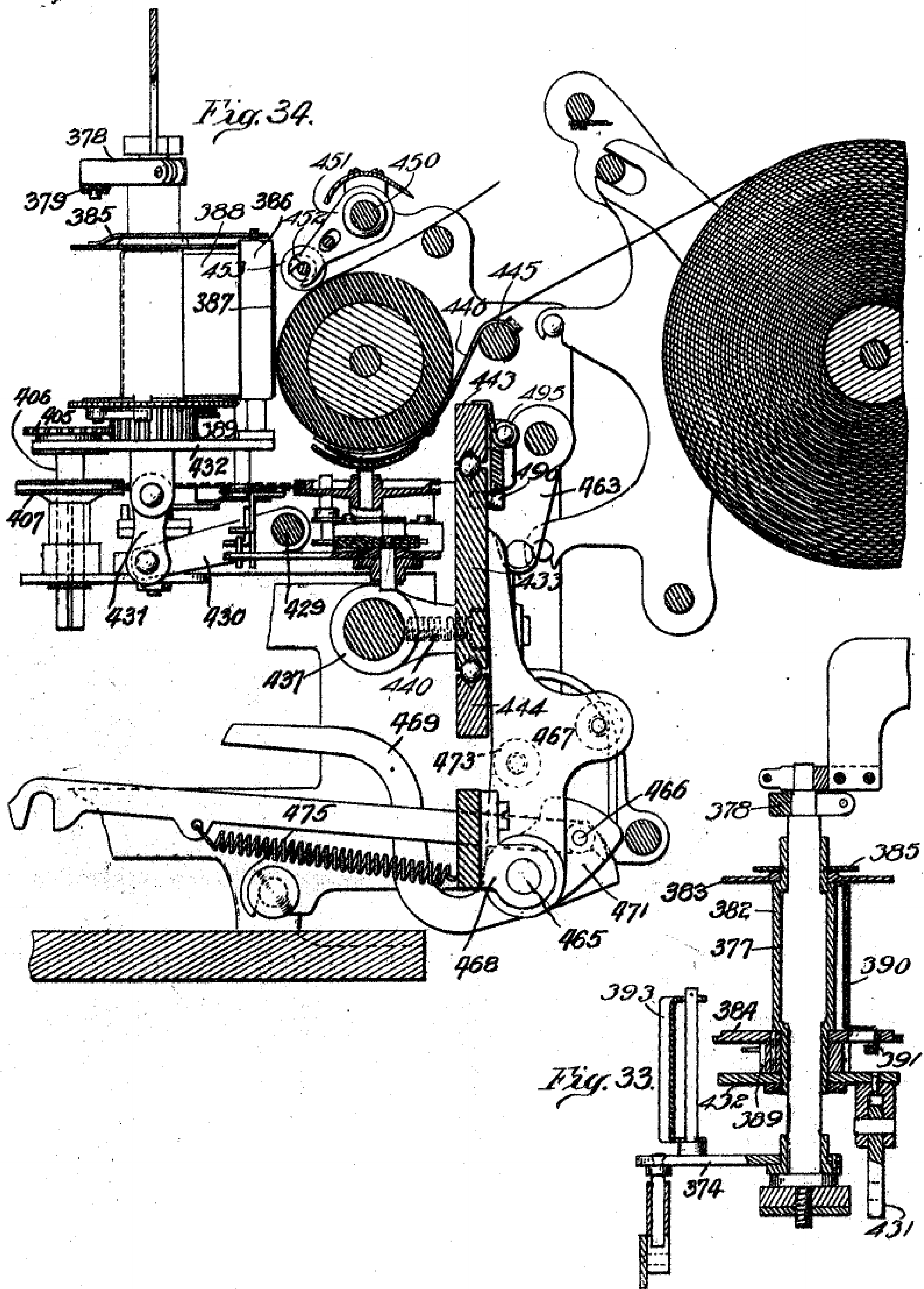
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Martin Teetor
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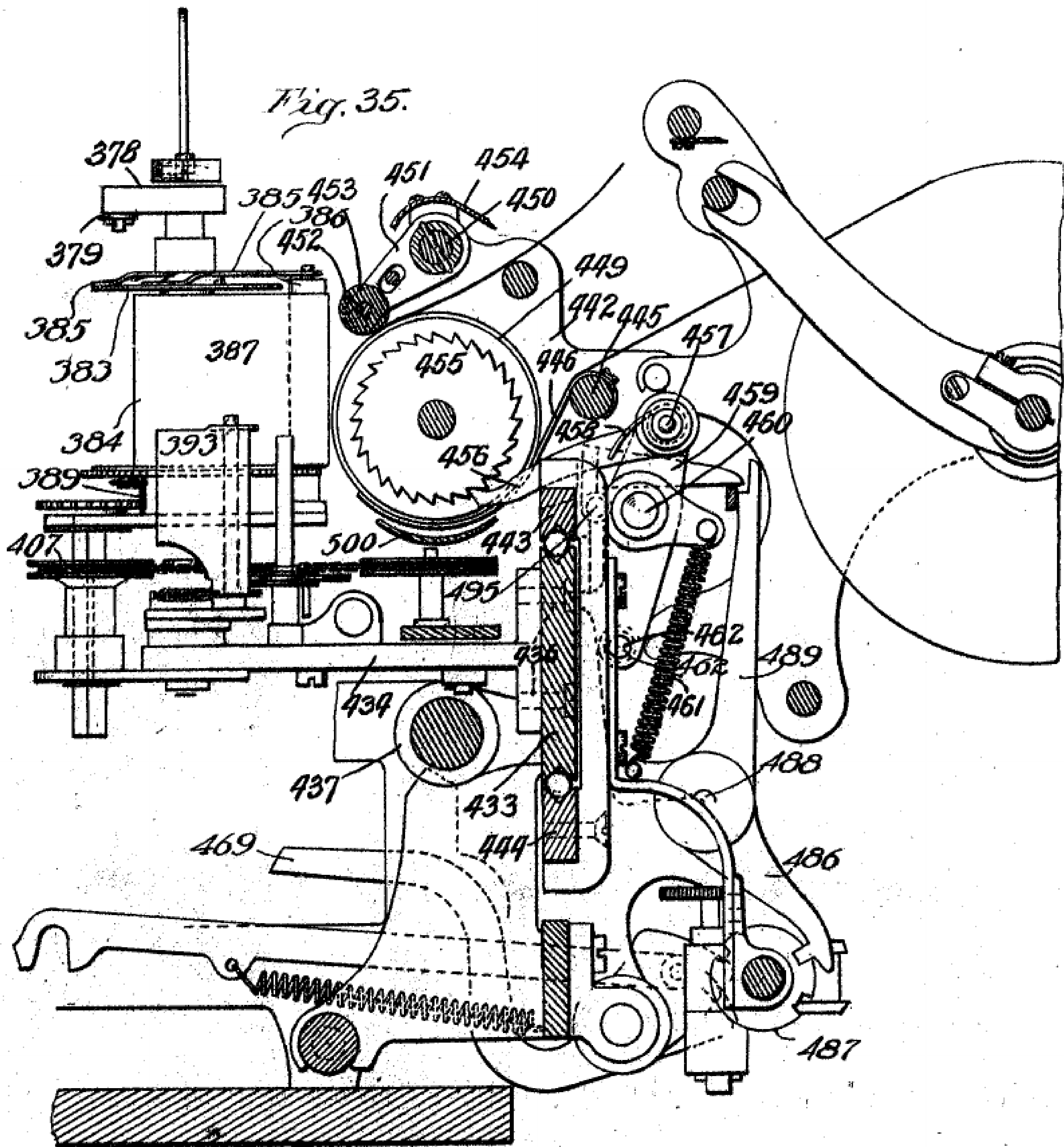
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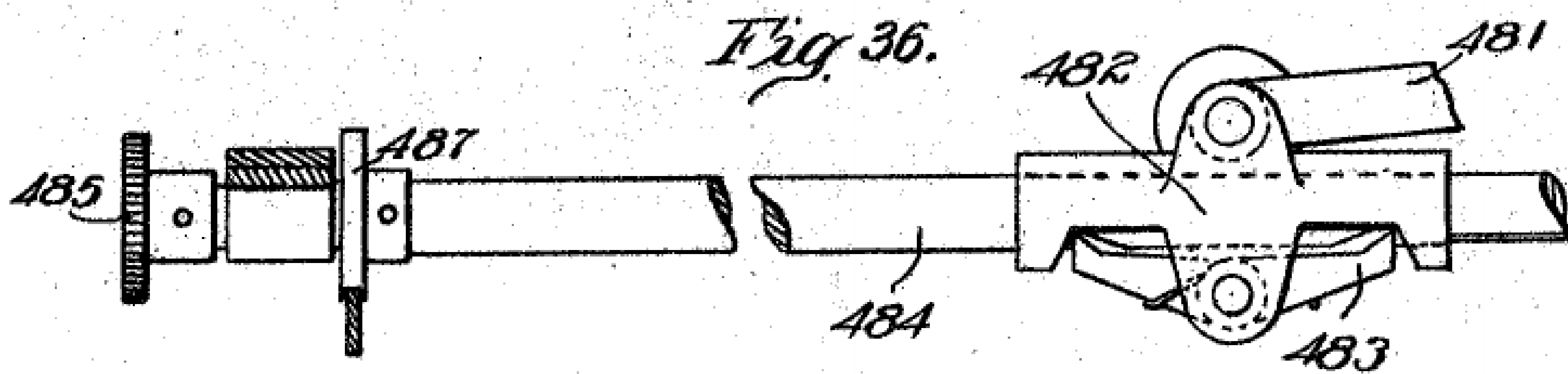
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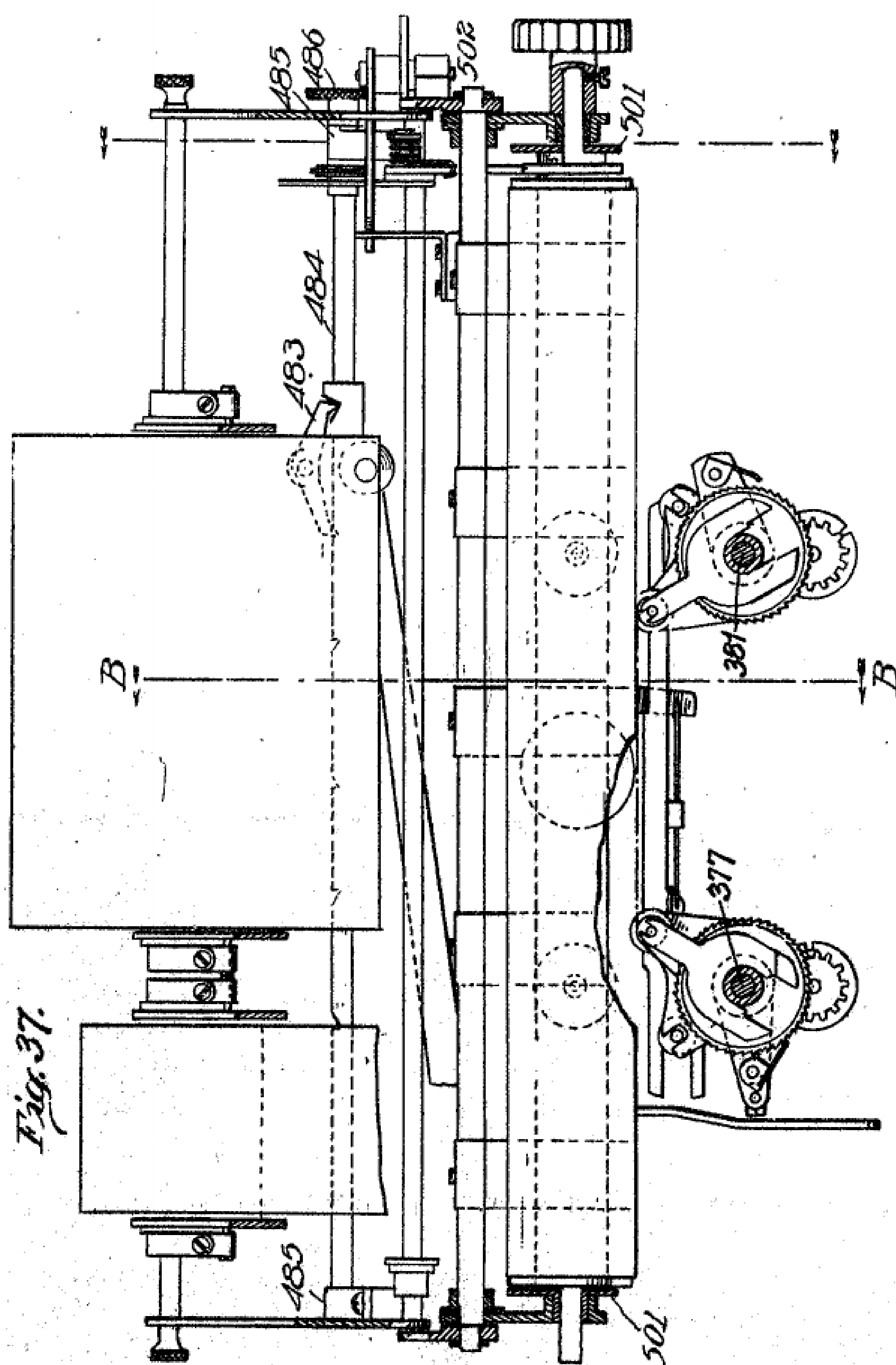
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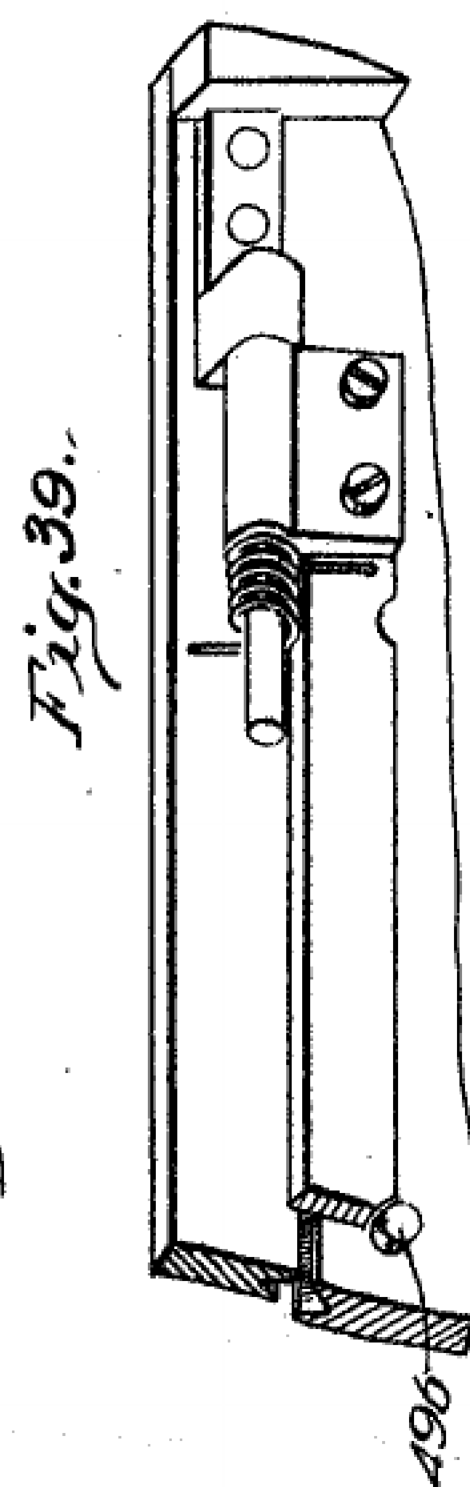
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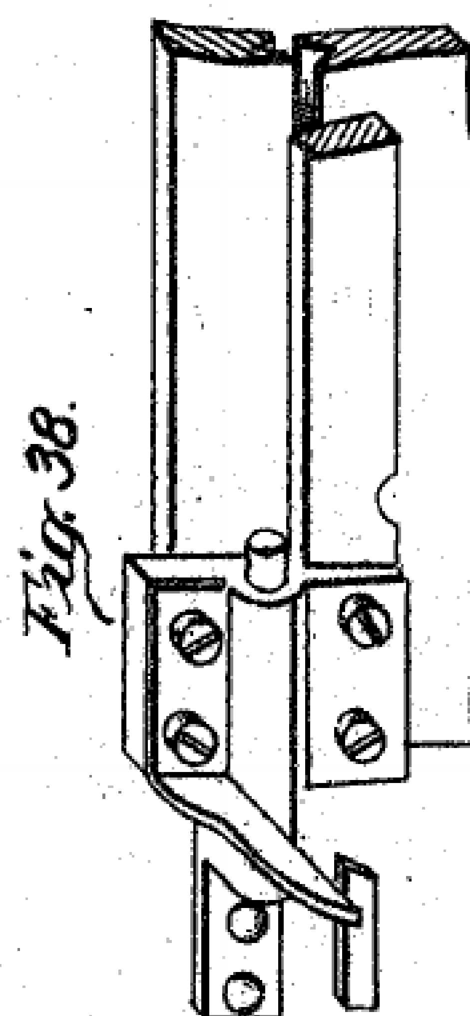
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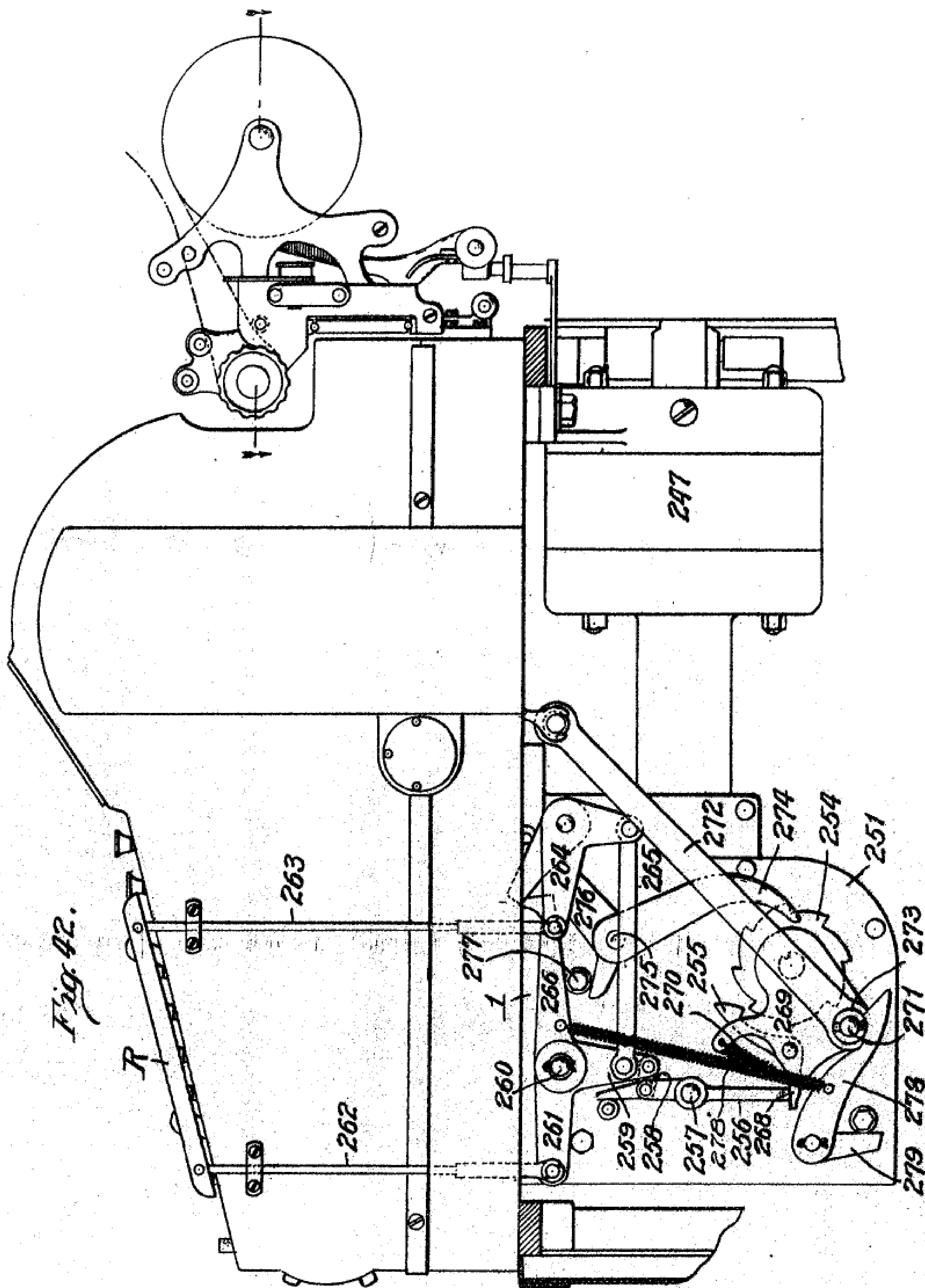
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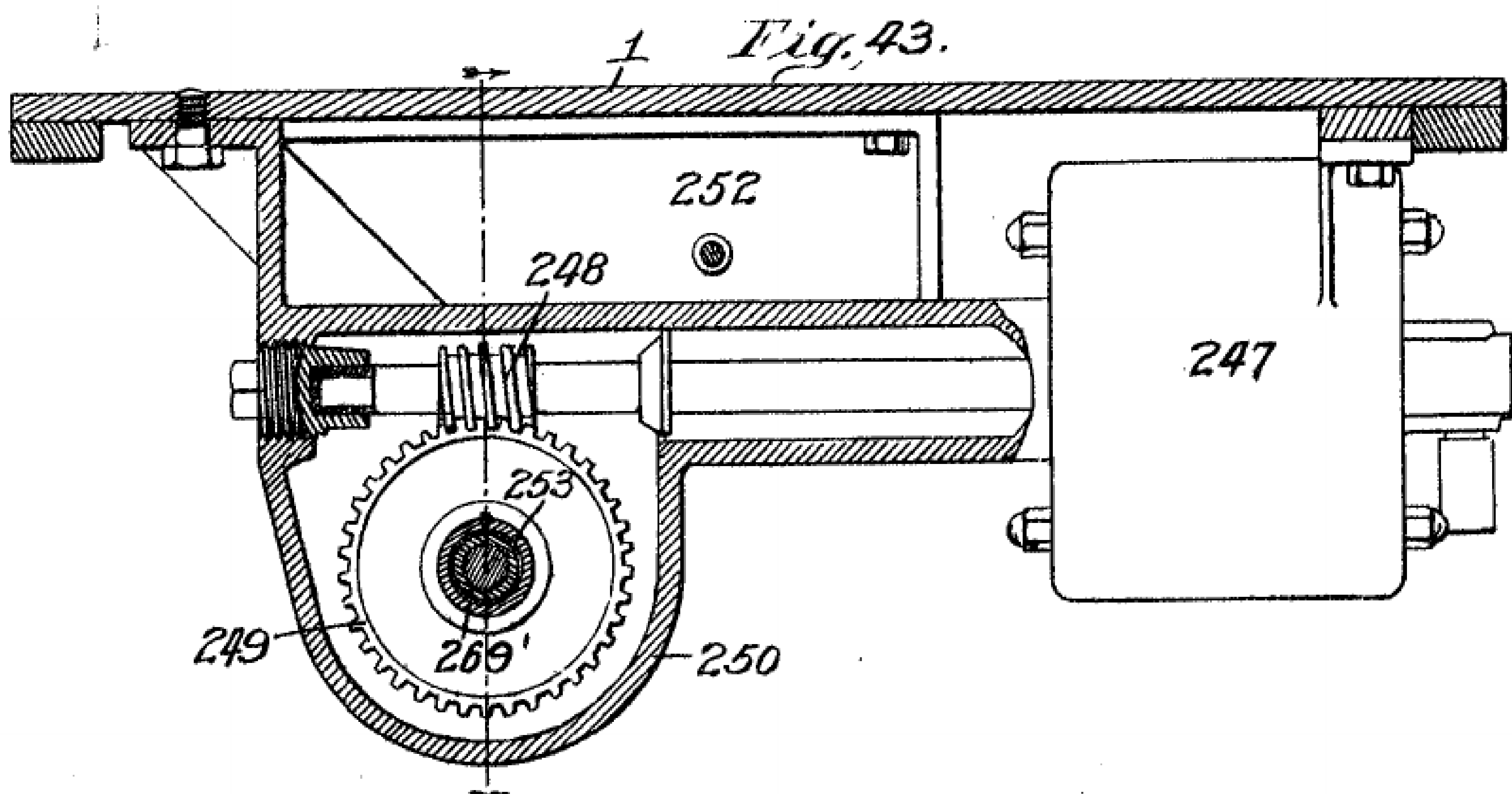


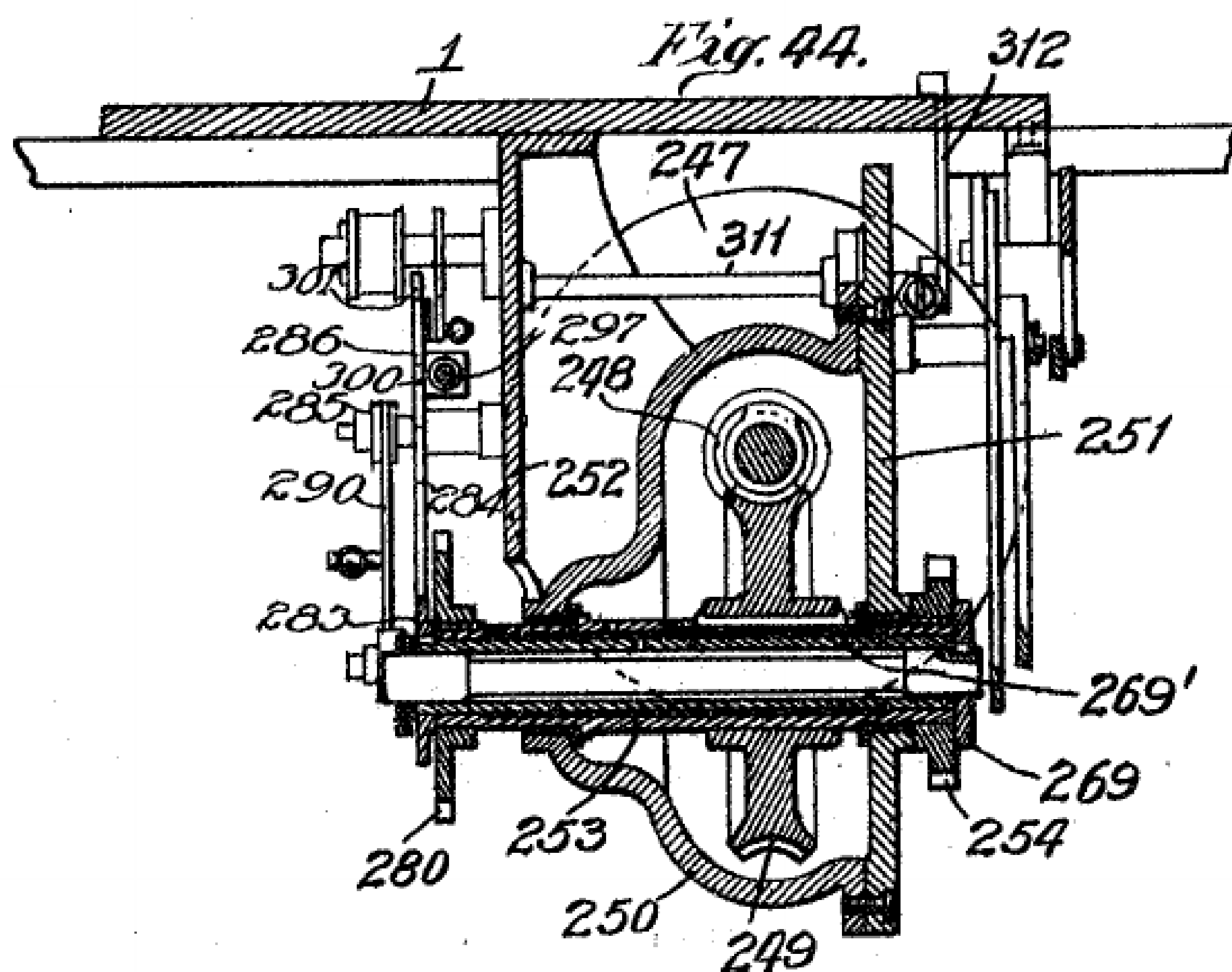
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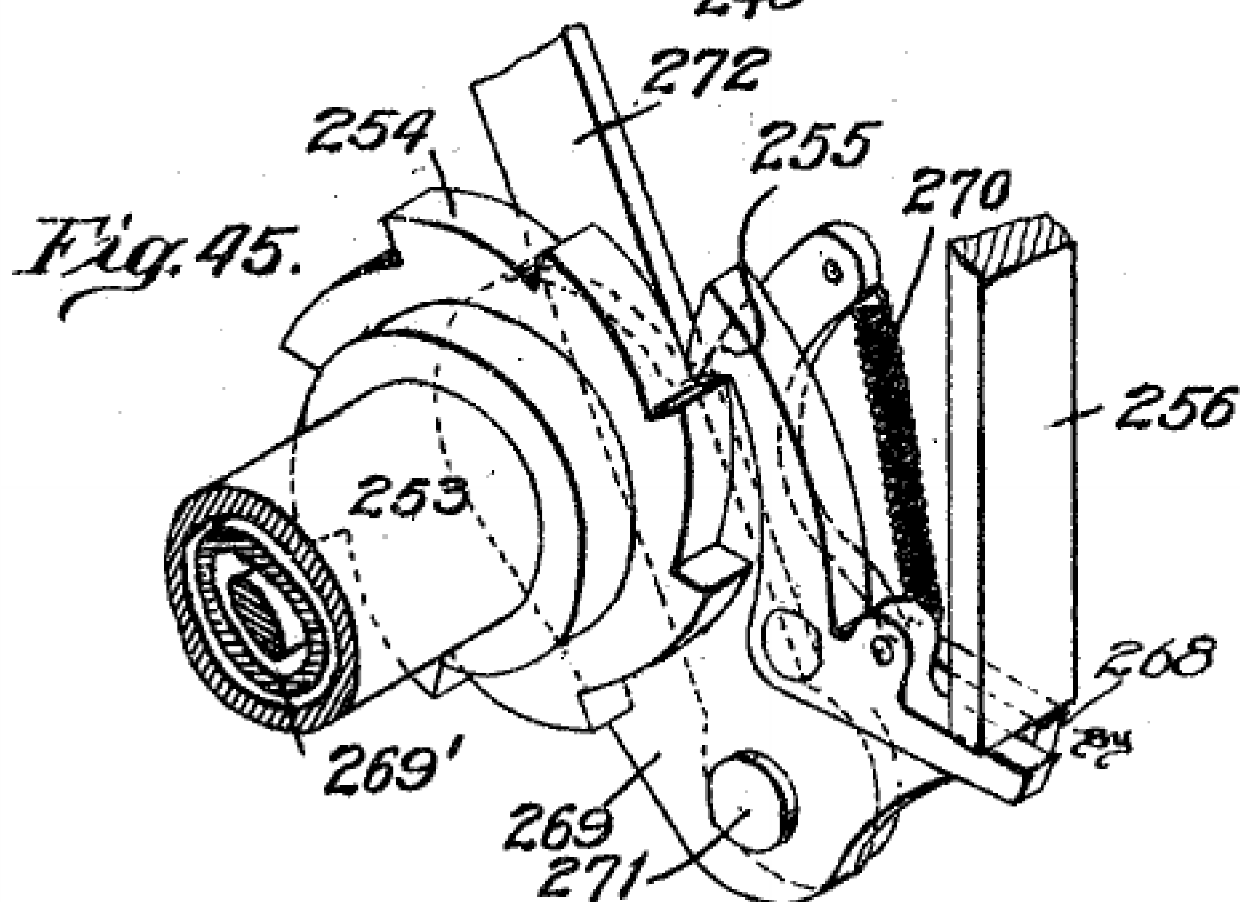
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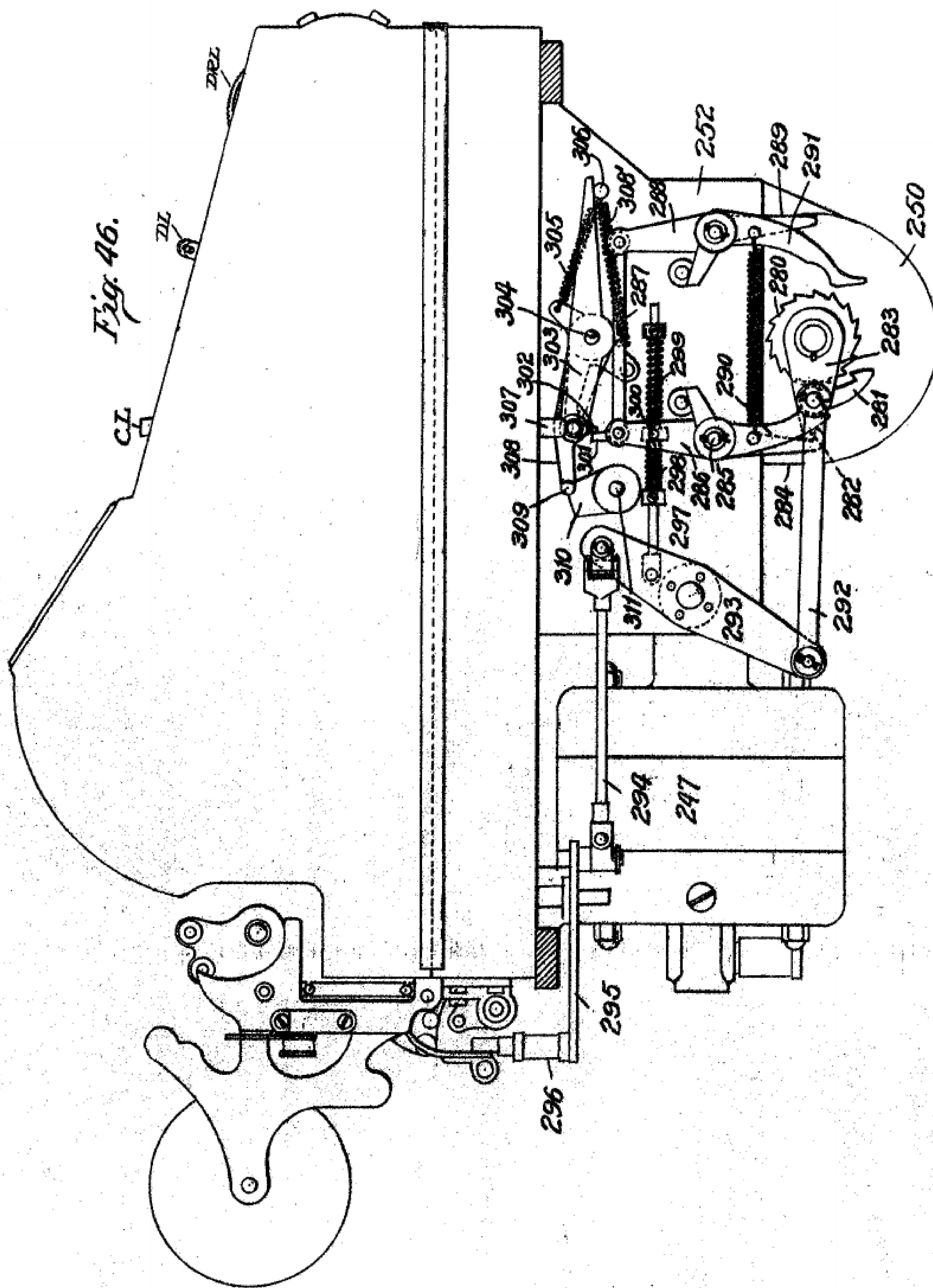
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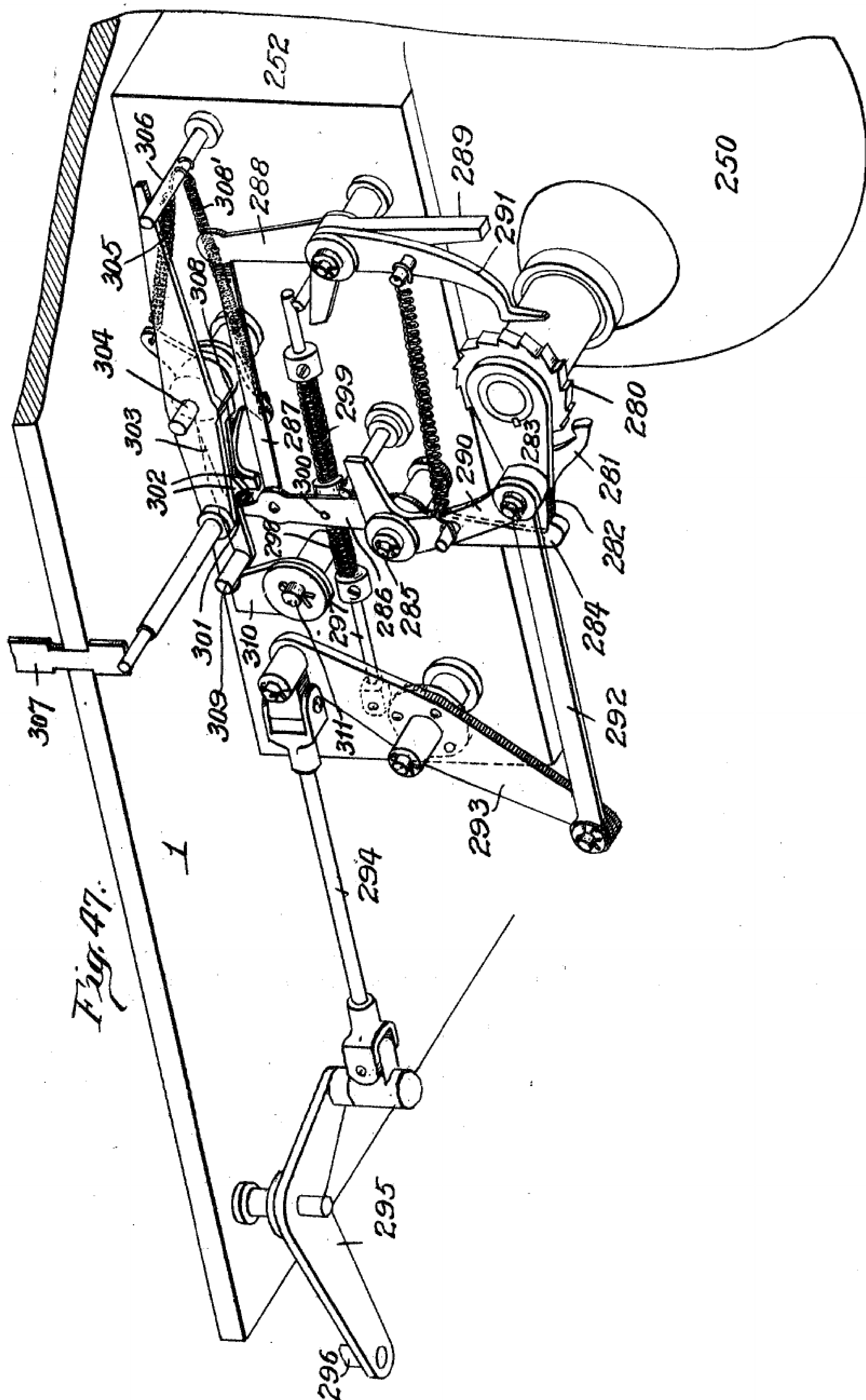


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Fig. 48.

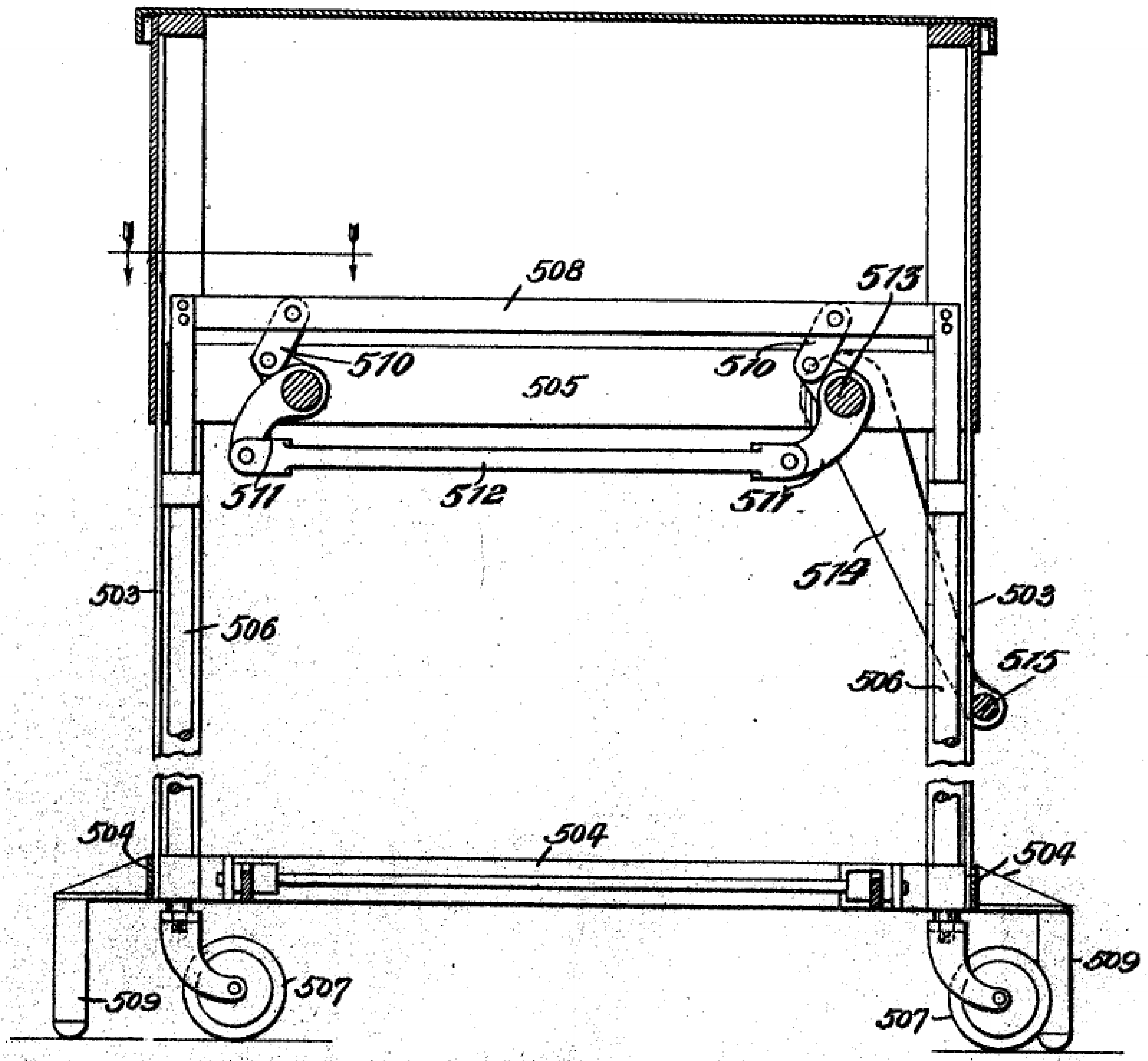
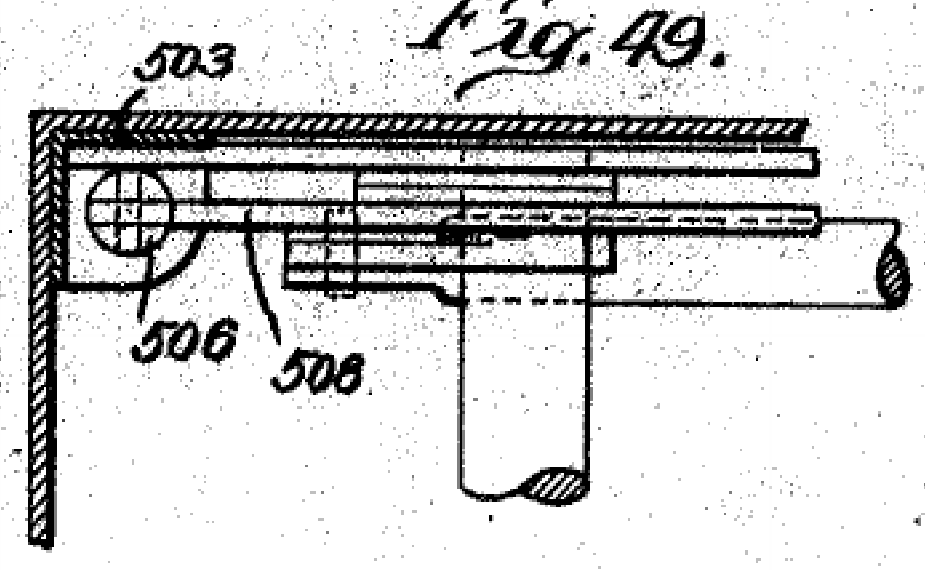


Fig. 49.



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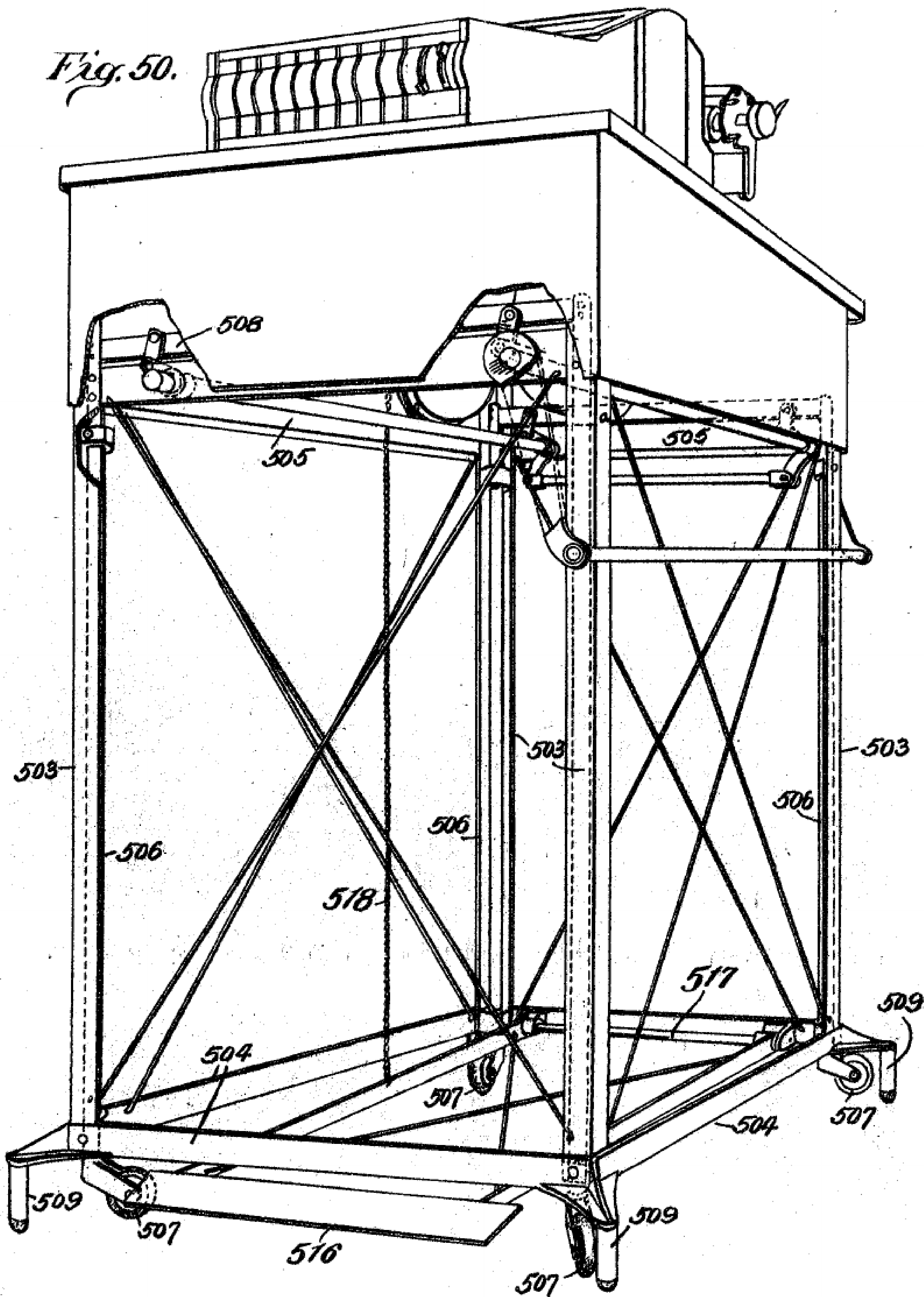
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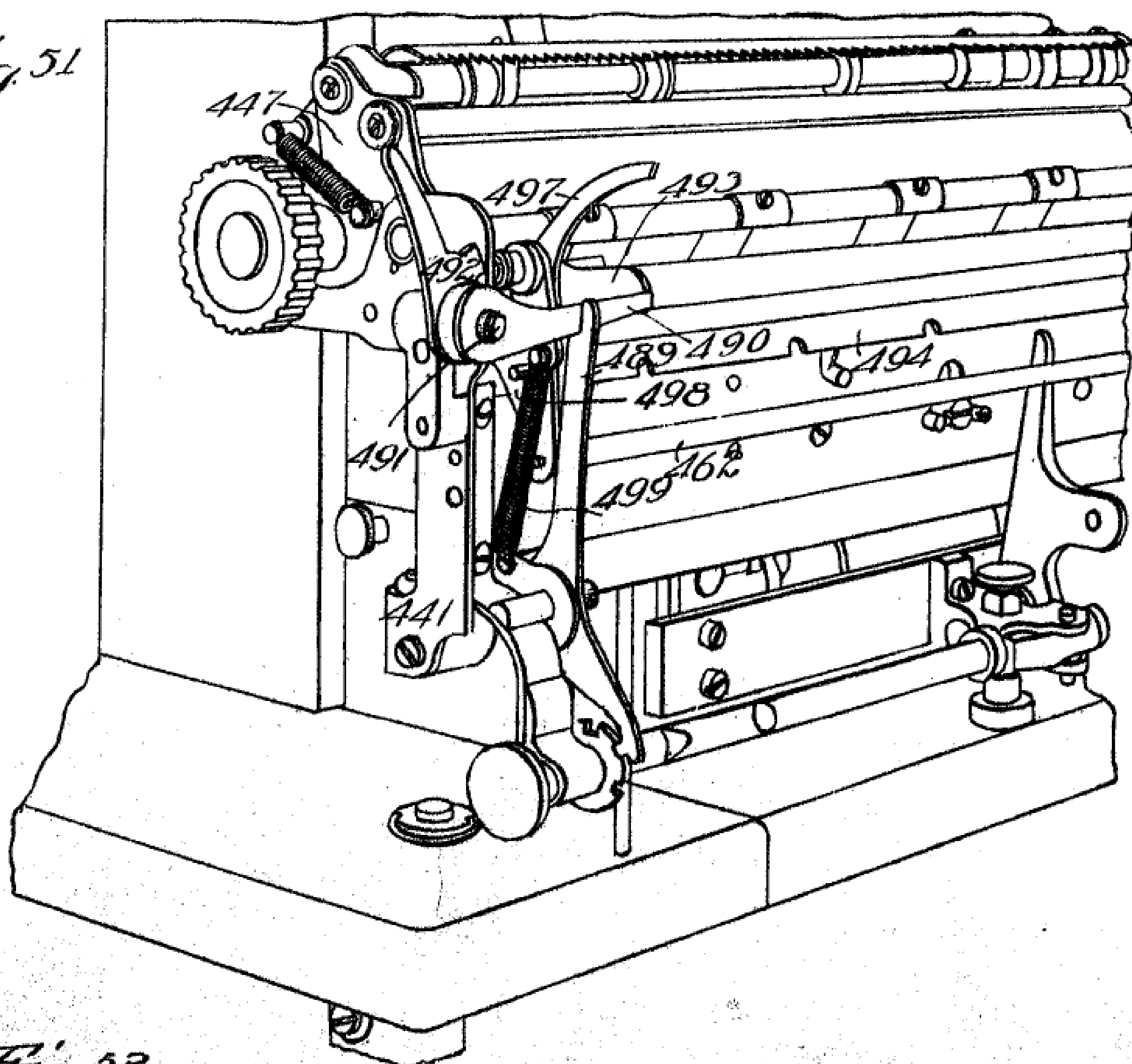
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Chicago, Illinois, U.S.A.

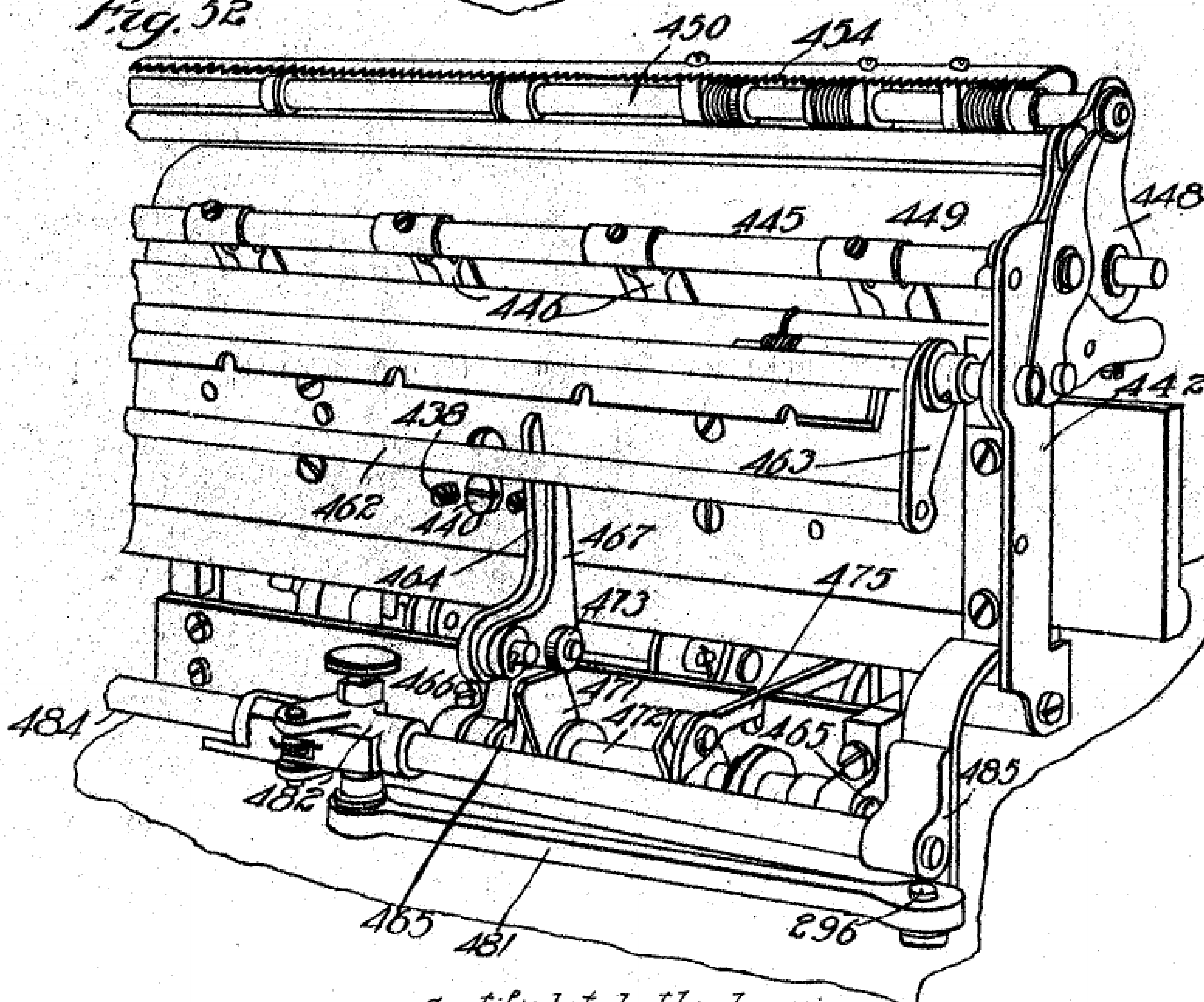
Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

Frederick F. Mason
Merrill M. Blackburn

1922 08 22 CA223159.Drawings p23.png

223159





certified to be the drawings referred to in the specification here unto annexed.

September 4 1920.
Chicago Illinois, U.S.A.

Frederick F. Mason
Merrill M. Blackburn

Inventor:
Martin Teetor
by Wallace R. Lane
Att'y.

1922 08 22 CA223159.Drawings p24.png

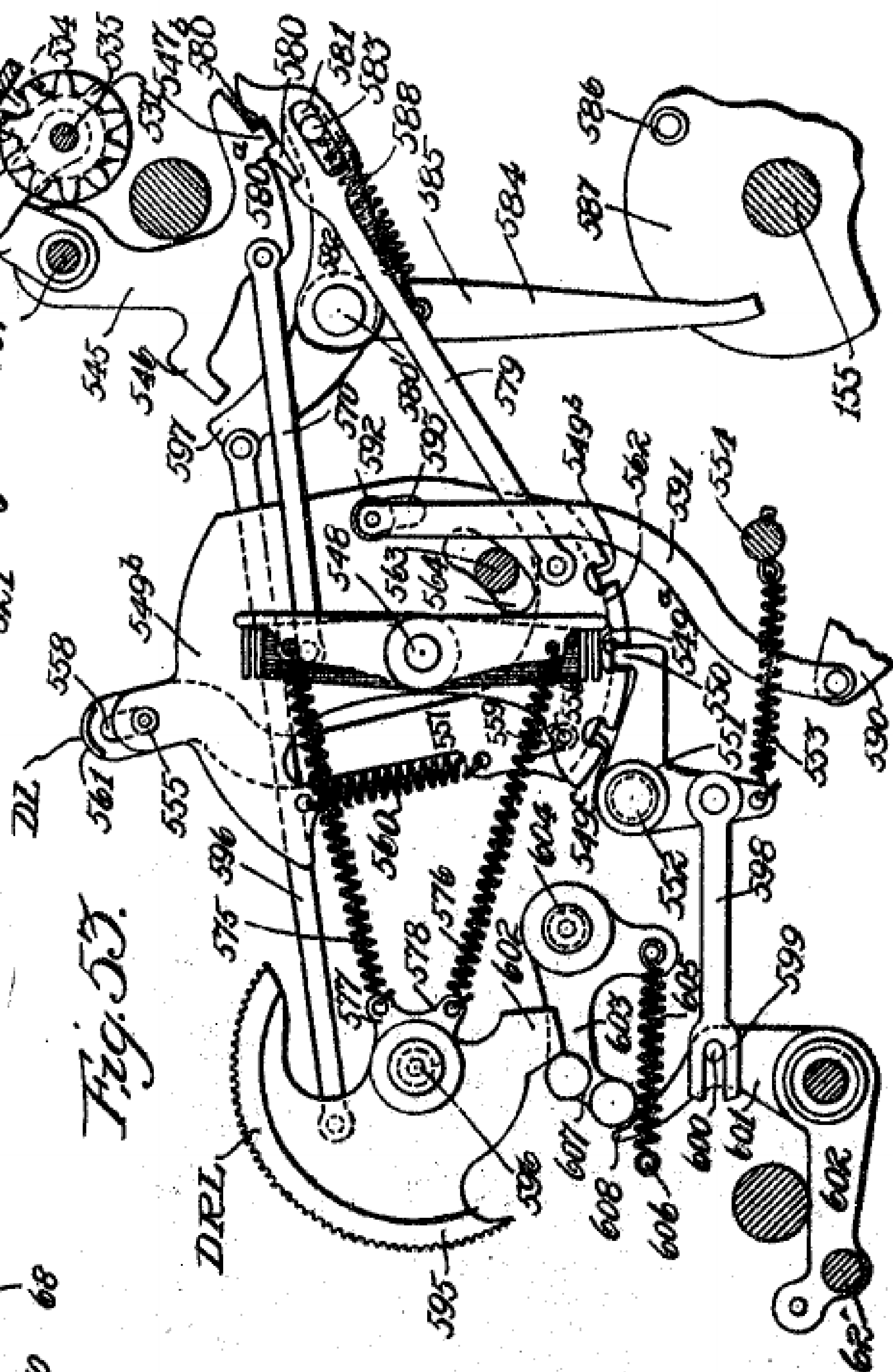


Fig. 53.

Fig. 54.

Certified to be the drawings referred to in the specification hereunto annexed.

September 4, 1920

Chicago, Illinois, U.S.A.

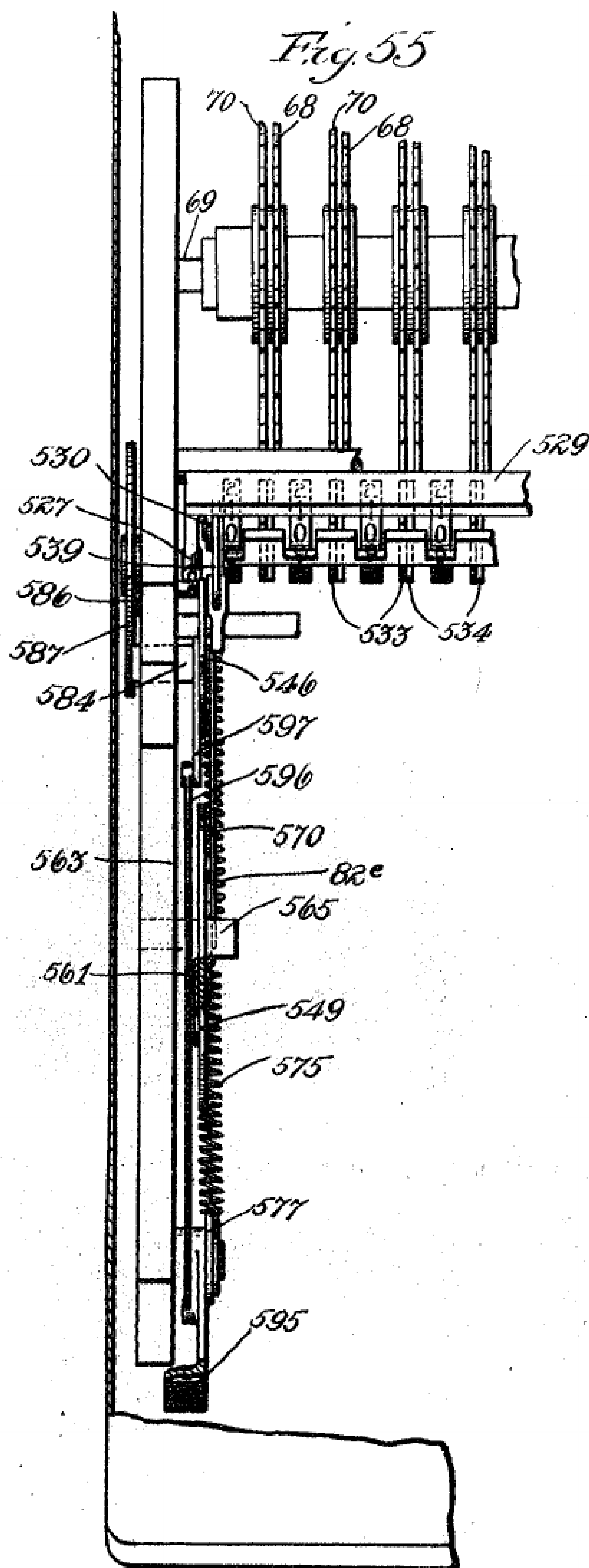
Inventor
Martin Tector
by Wallace R. Lane
Atty

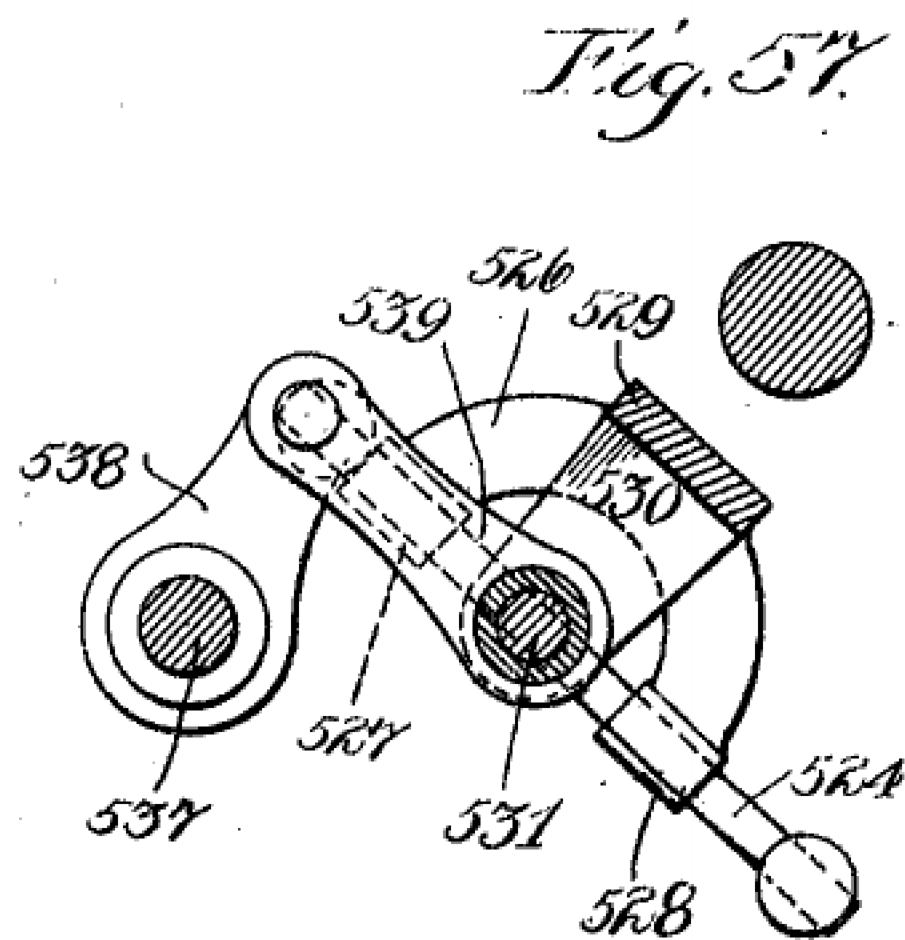
Frederick F. Mason

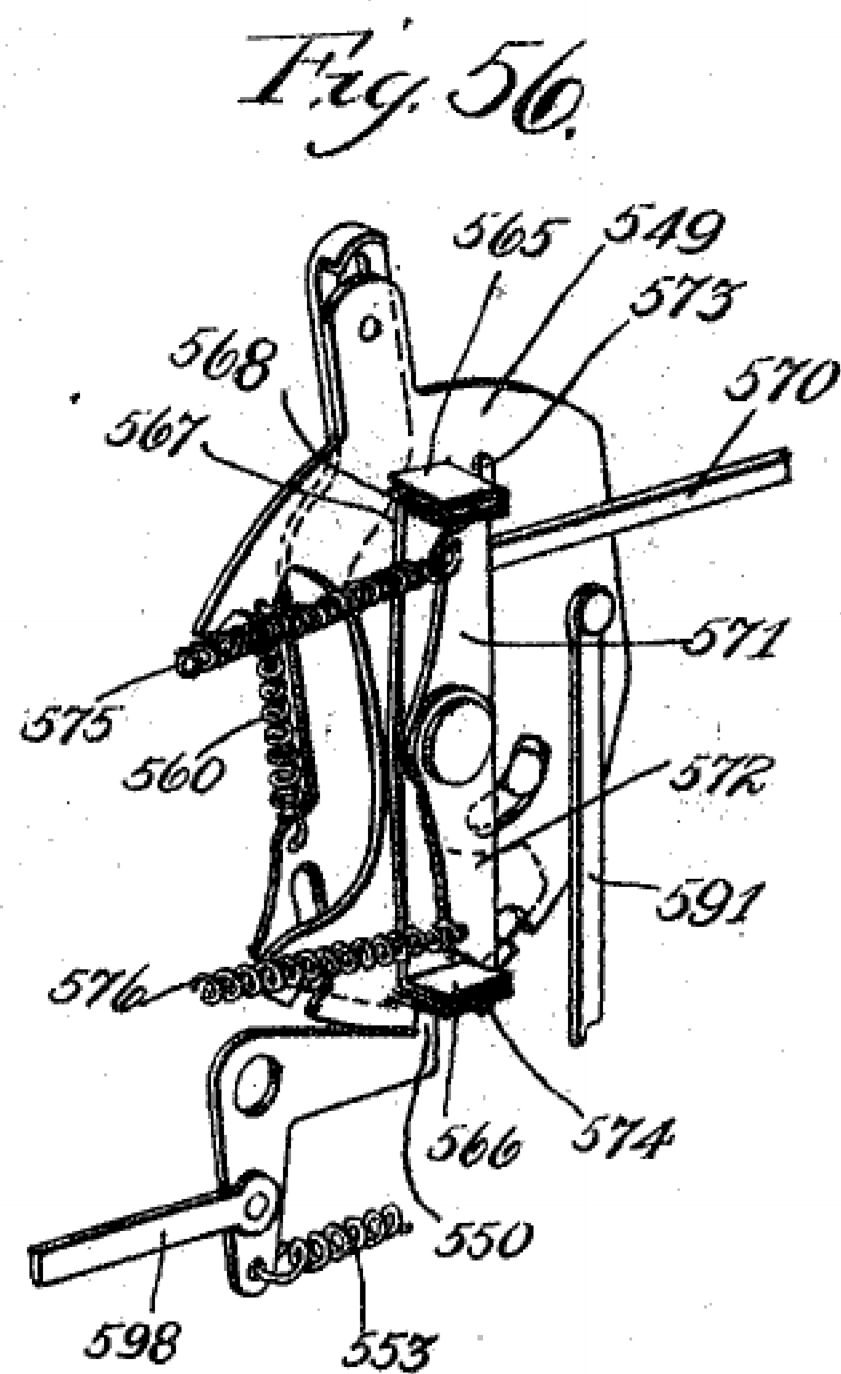
Merrill M. Blackburn

1922 08 22 CA223159.Drawings p25.png

1184







Certified to be the drawings referred to in the specification hereunto annexed.
September 4 1920
Chicago, Illinois U.S.A.

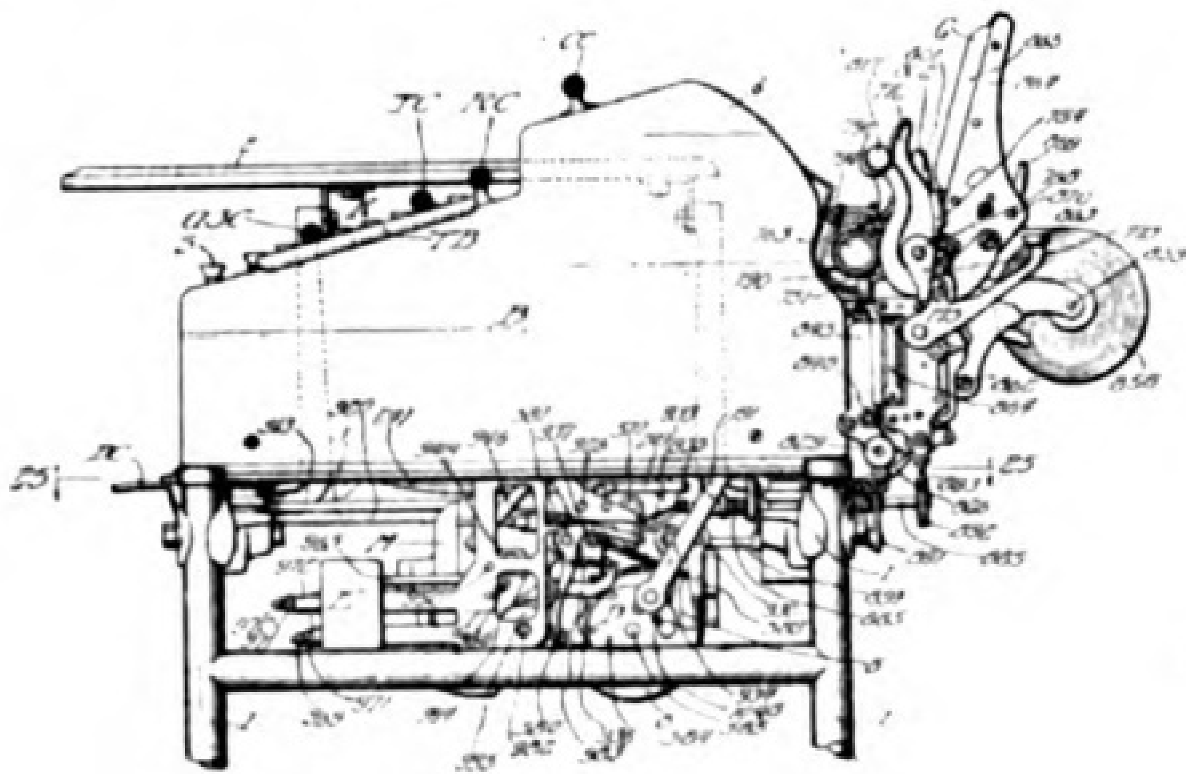
Witness:
Frederick F. Mason.
Merrill M. Blackburn

INVENTOR.
Martin Teetor
by Wallace R. Lane
Att'y.

1922 08 22 CA223159.Drawings p26.png

NEXT ITEM

1,558,947. CACULATING MACHINE. MARTIN TEETOR, Des Moines, Iowa, assignor to Teetor Company, Des Moines, Iowa, a Corporation of Iowa. Filed May 1, 1920. Serial No. 378,246. 44 Claims. (Cl. 235—60.)



1. In a machine of the character described, a set of dial wheels, a set of overdraft or net credit dial wheels, a set of sectors for operating the first set of dial wheels, a set of sectors for operating the second set of dial wheels, connecting means between the sectors for operating a sector of one set by a sector of the other set, and means for releasing the connection so that one sector may move relatively to its connected sector.

1925 10 27 - USPO v339 p943 Teetor.png

NEXT ITEM

Oct. 27, 1925.

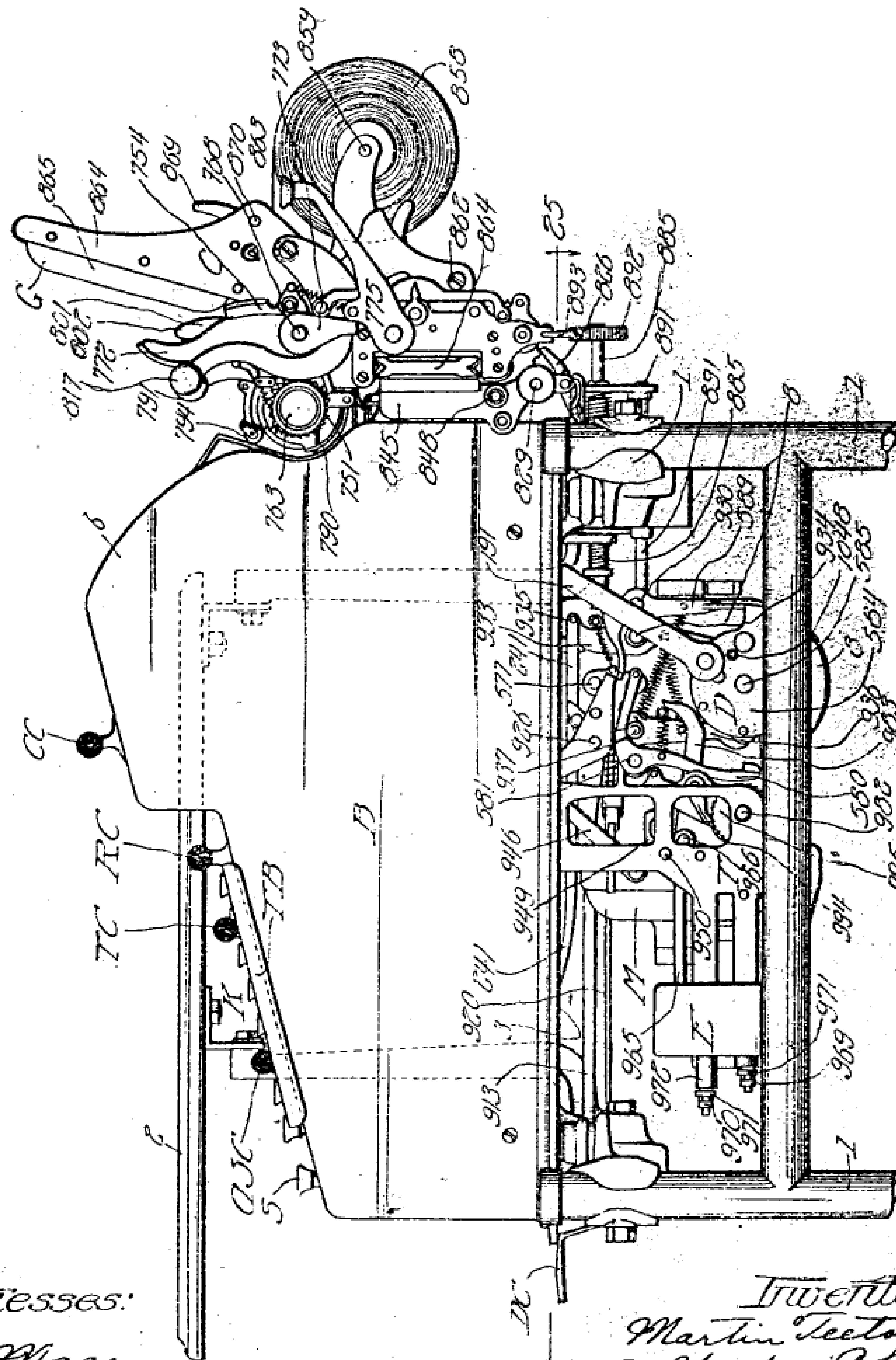
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 1



Witnesses:
F. F. Mason
Arthur W. Carlson

Inventor.
Martin Teetor
By Wallace R. Lane
Atty.

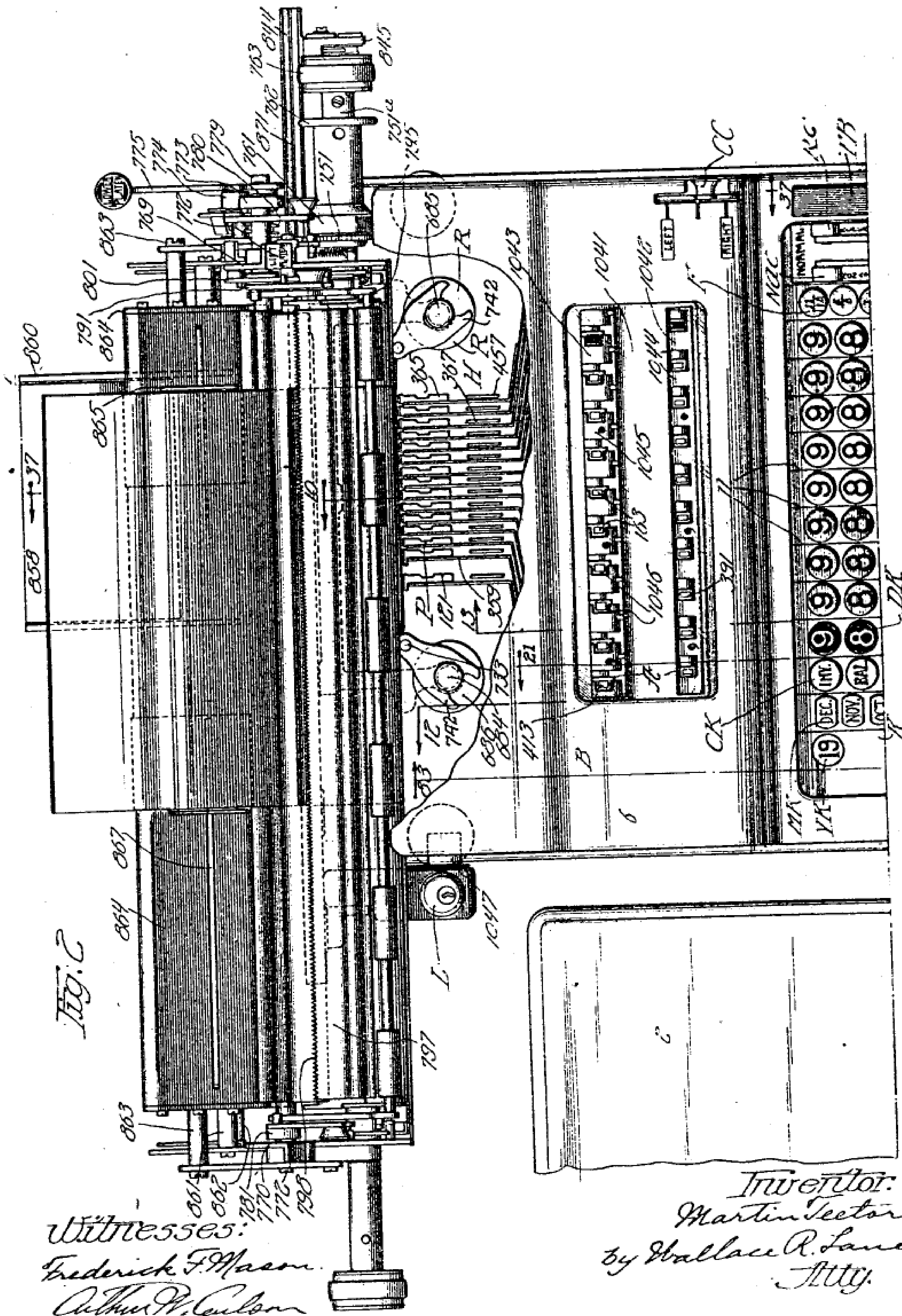
1925 10 27 US1558947 p01.png

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 2



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

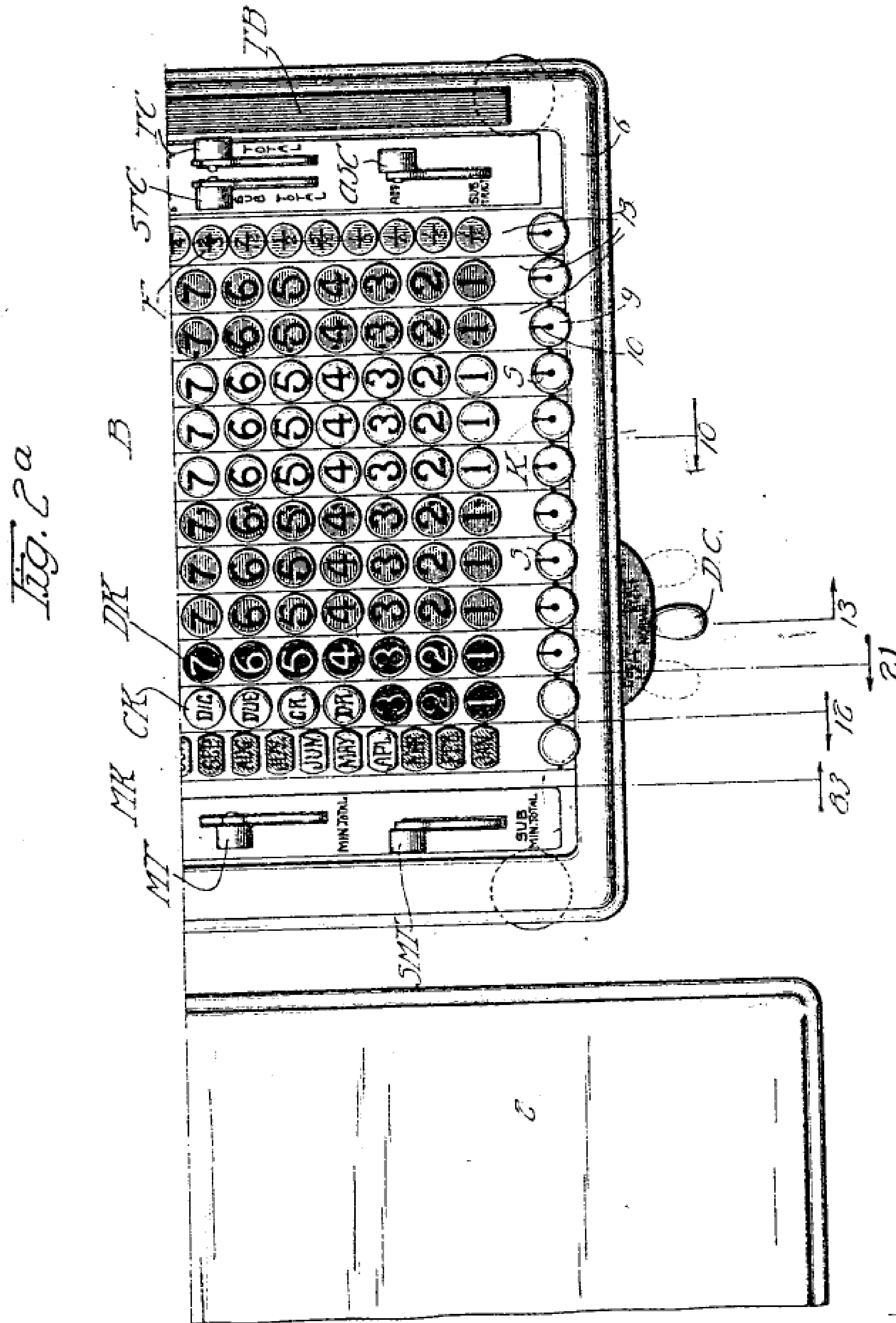
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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 3



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

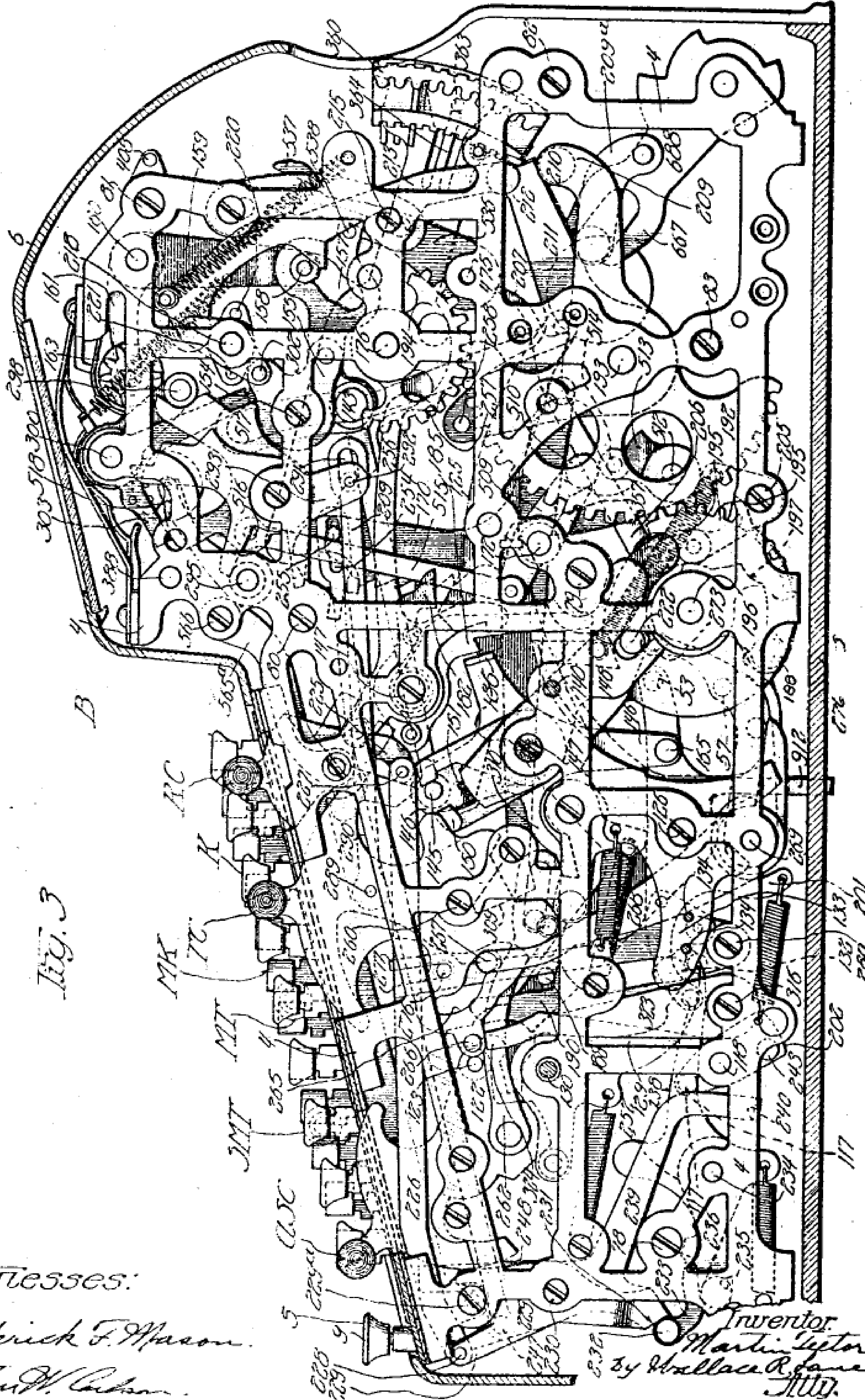
1925 10 27 US1558947 p03.png

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 4



Witnesses:

Frederick F. Mason

Arthur W. Carlson

Inventor

Martin Teetor

by Wallace R. Lane

Atty.

1925 10 27 US1558947 p04.png

Oct. 27, 1925.

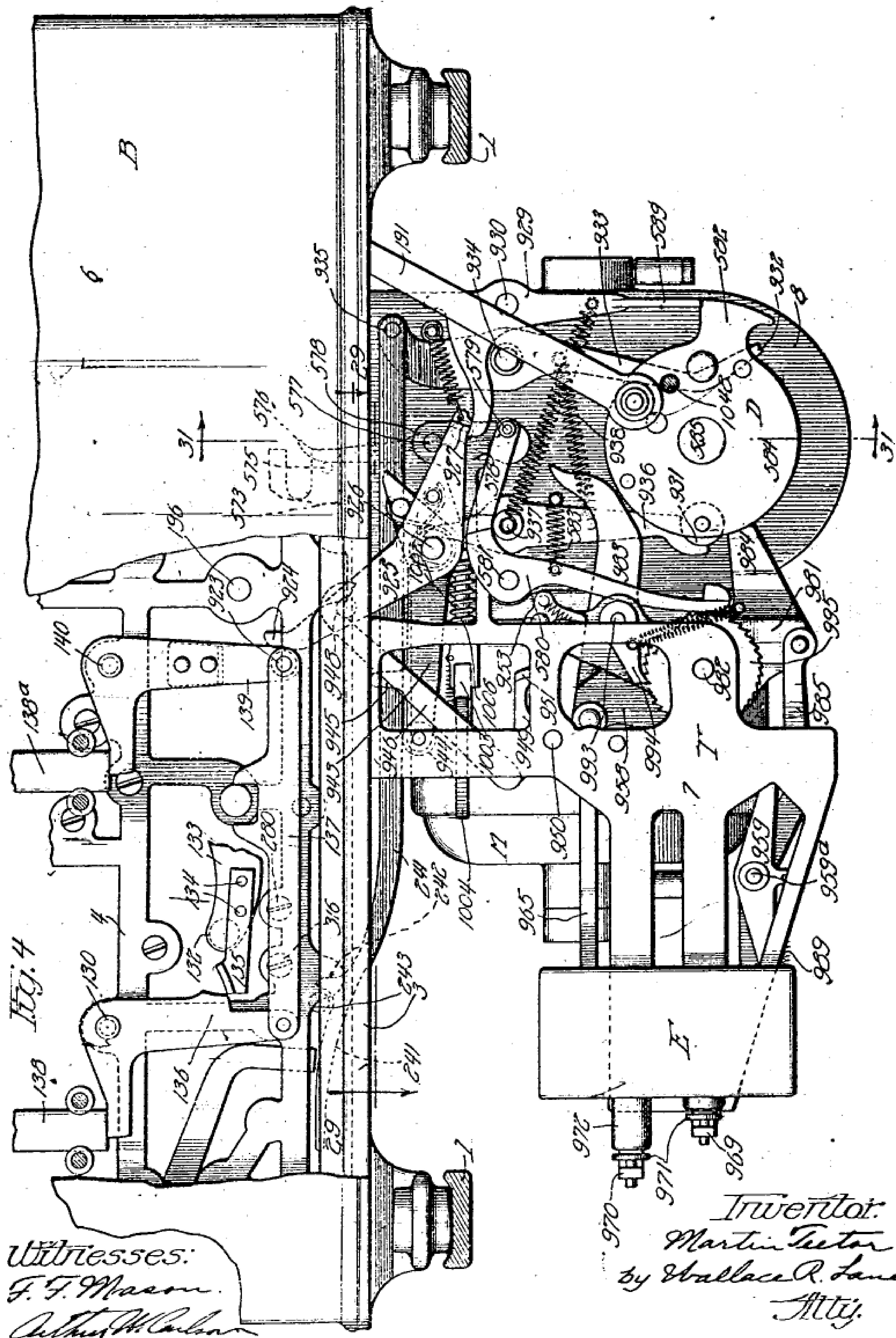
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 5



1925 10 27 US1558947 p05.png

Oct. 27, 1925.

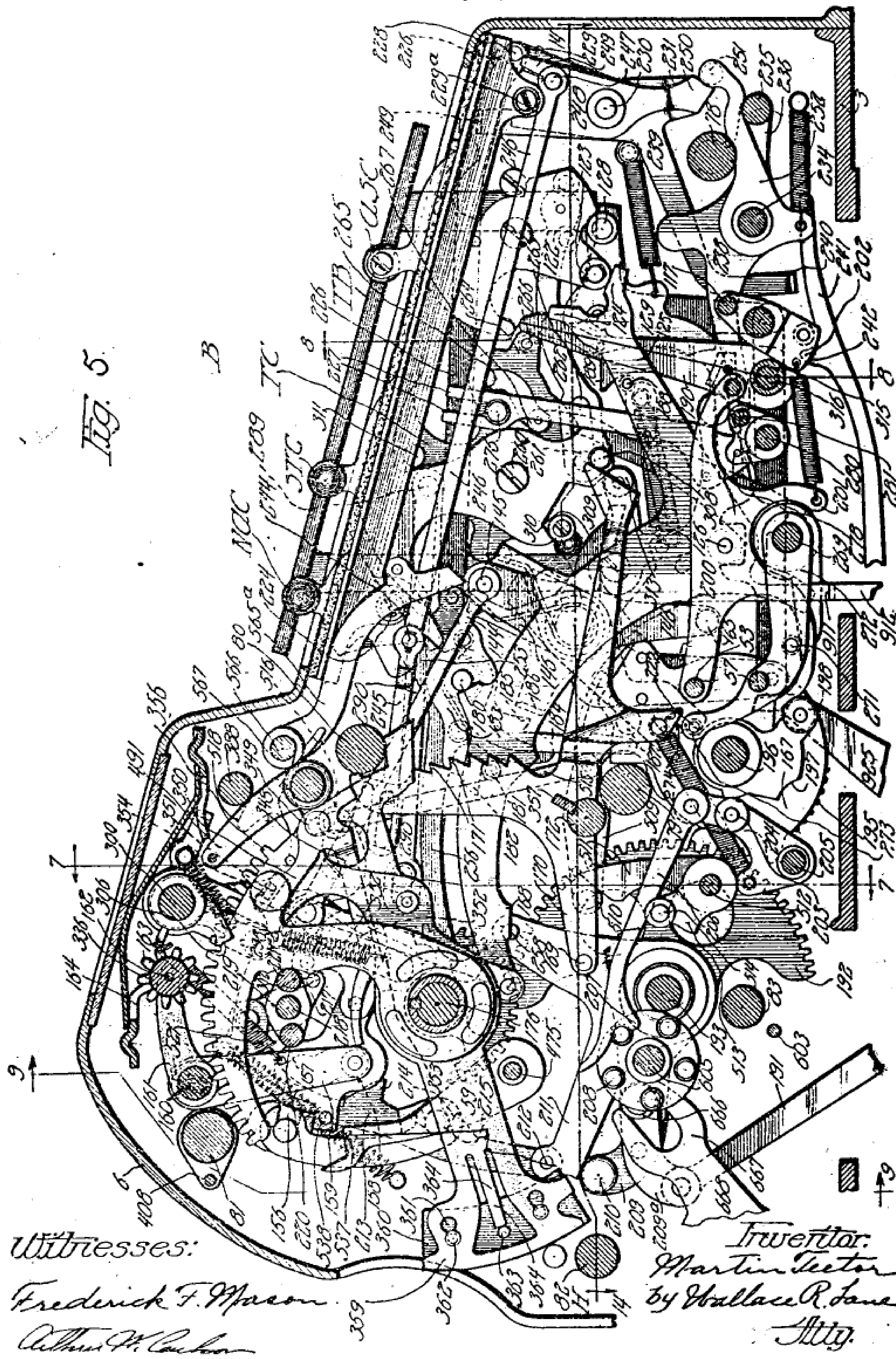
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 6



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p06.png

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

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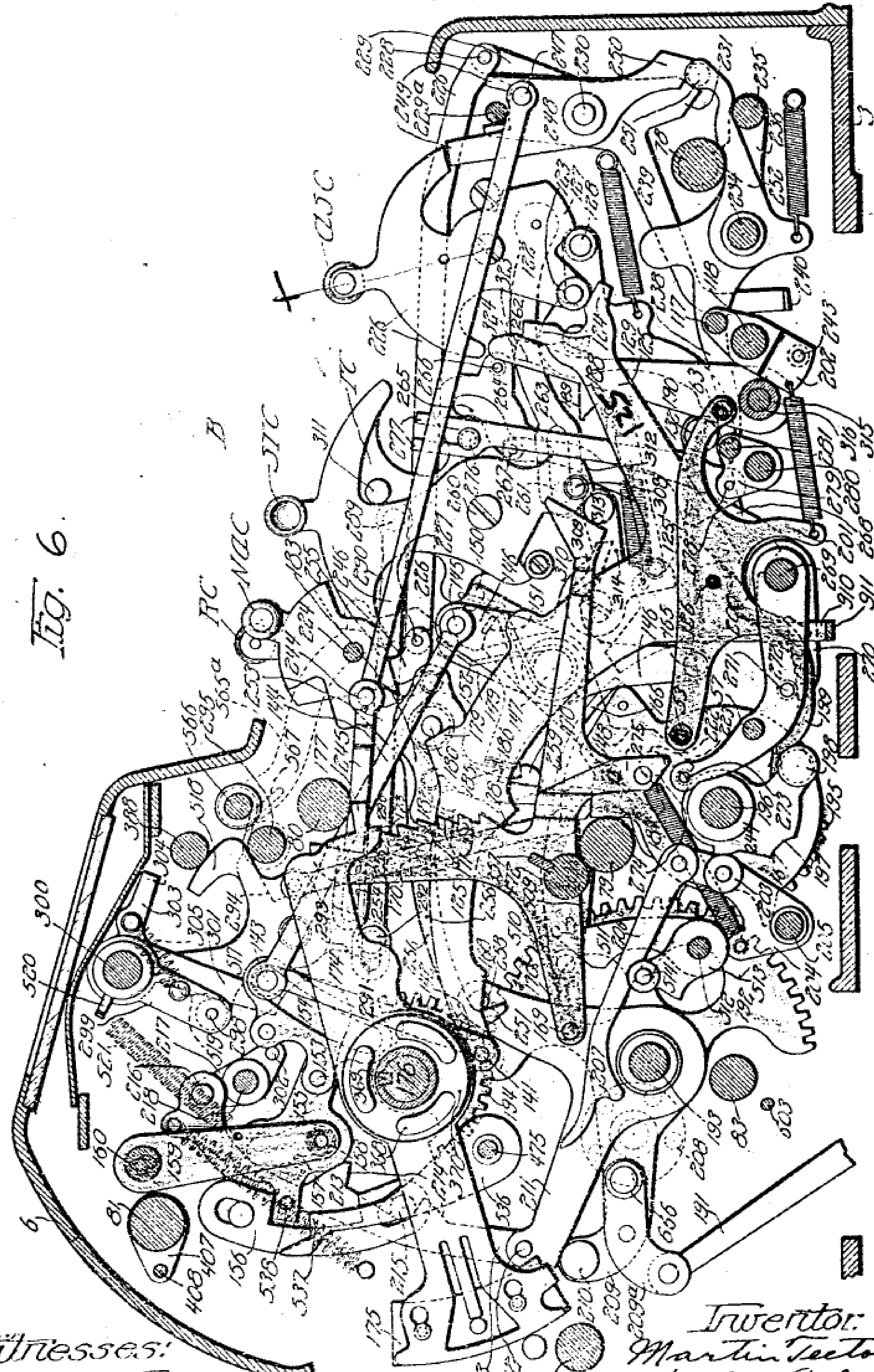


Fig. 6

Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p07.png

Oct. 27, 1925.

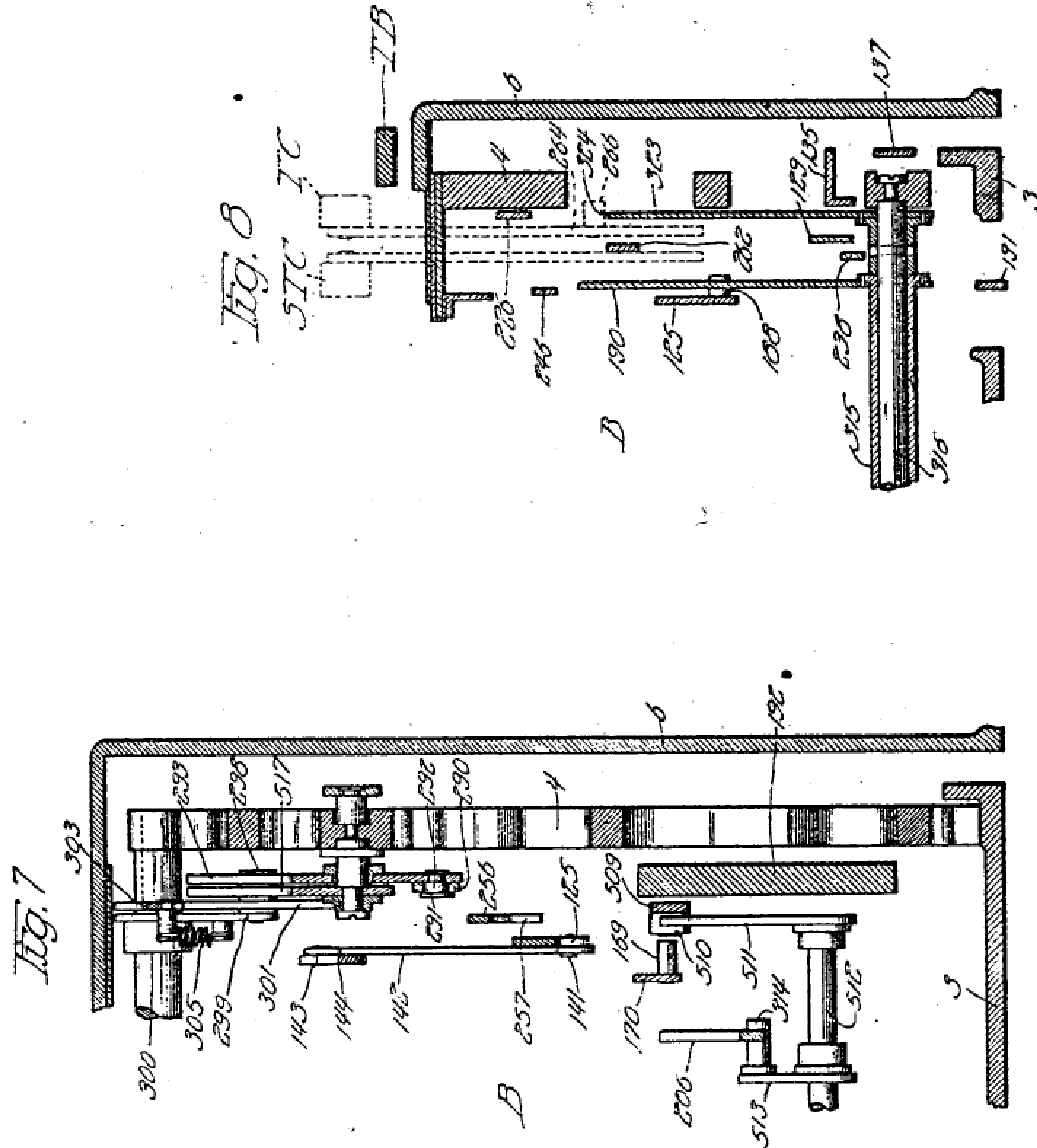
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 8



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p08.png

Oct. 27, 1925.

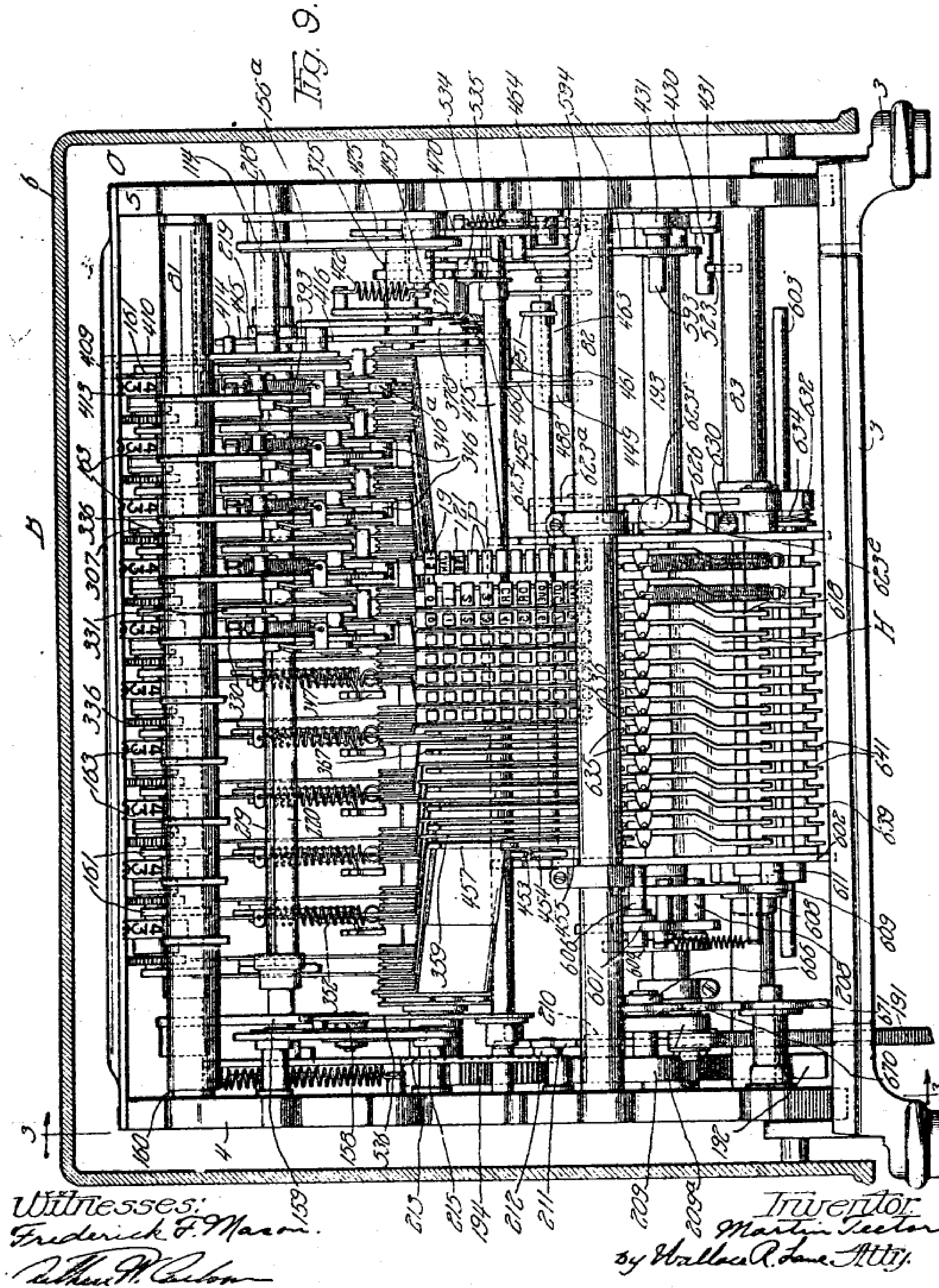
M. TEETOR

1,558,947

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 9



1925 10 27 US1558947 p09.png

Oct. 27, 1925.

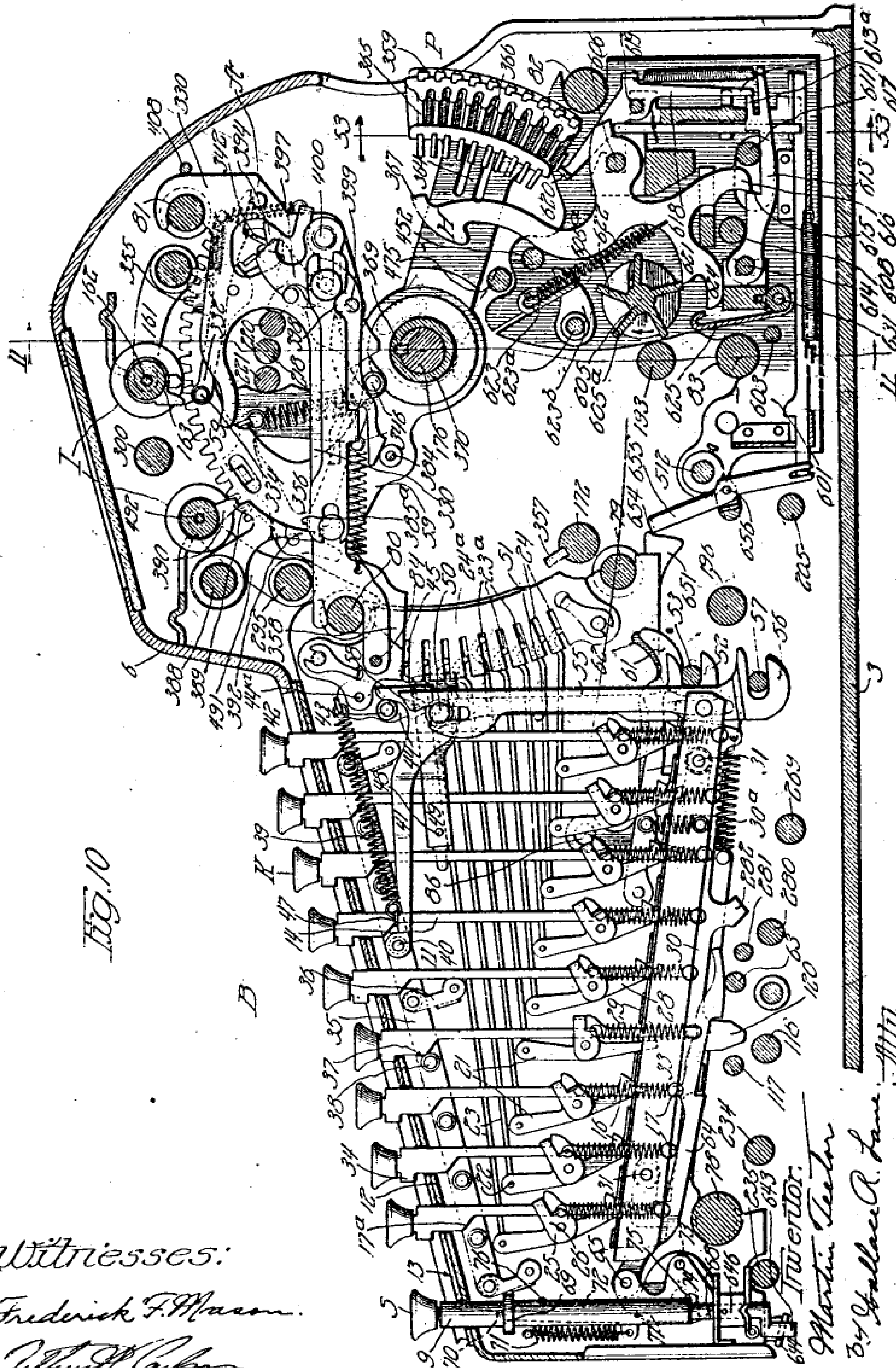
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 10



Witnesses:
Frederick F. Mason
[illegible]

Inventor:
Martin Teetor
By Wallace R. Lane
Atty

1925 10 27 US1558947 p10.png

Oct. 27, 1925.

1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 11

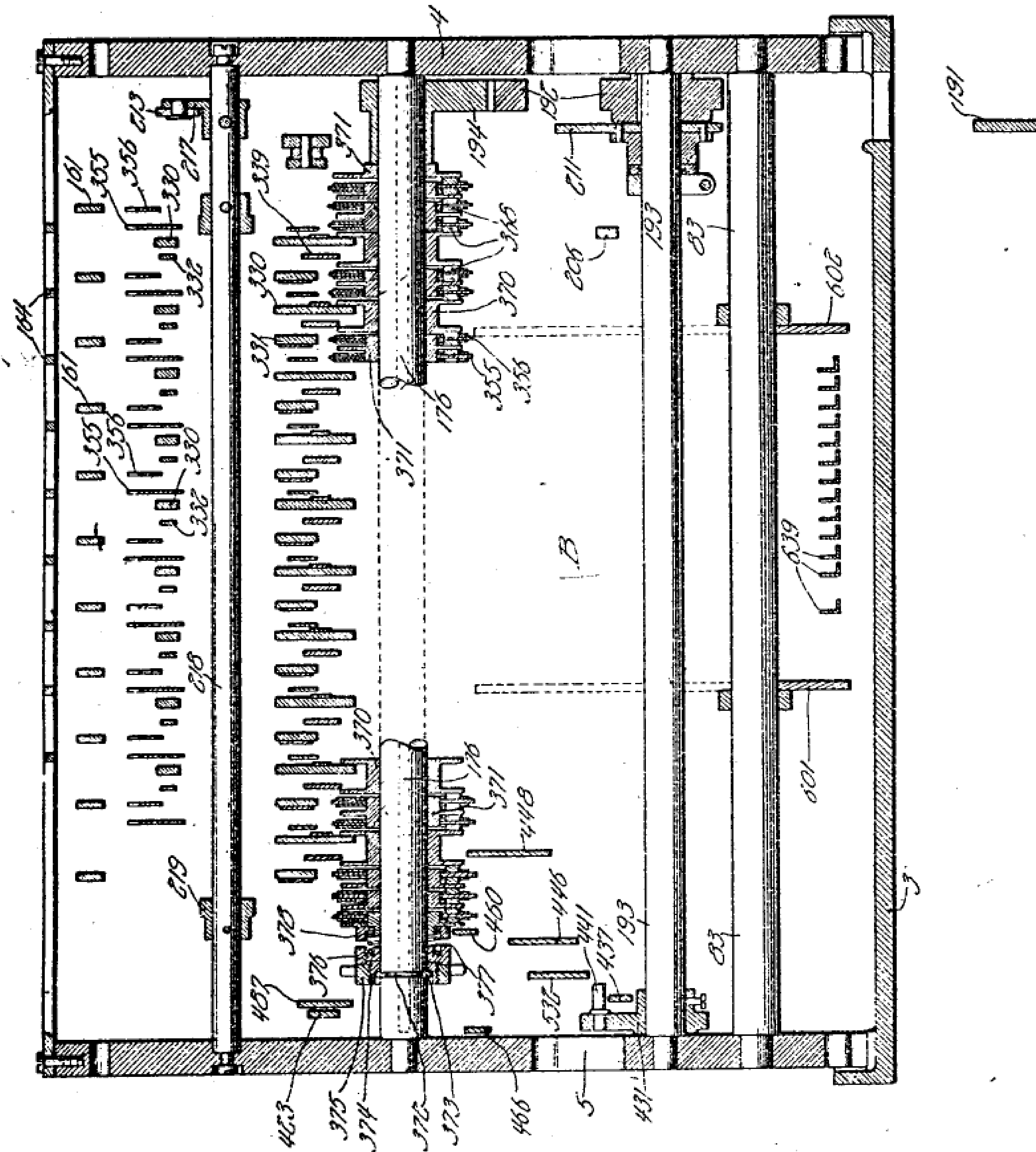


Fig. 11

Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

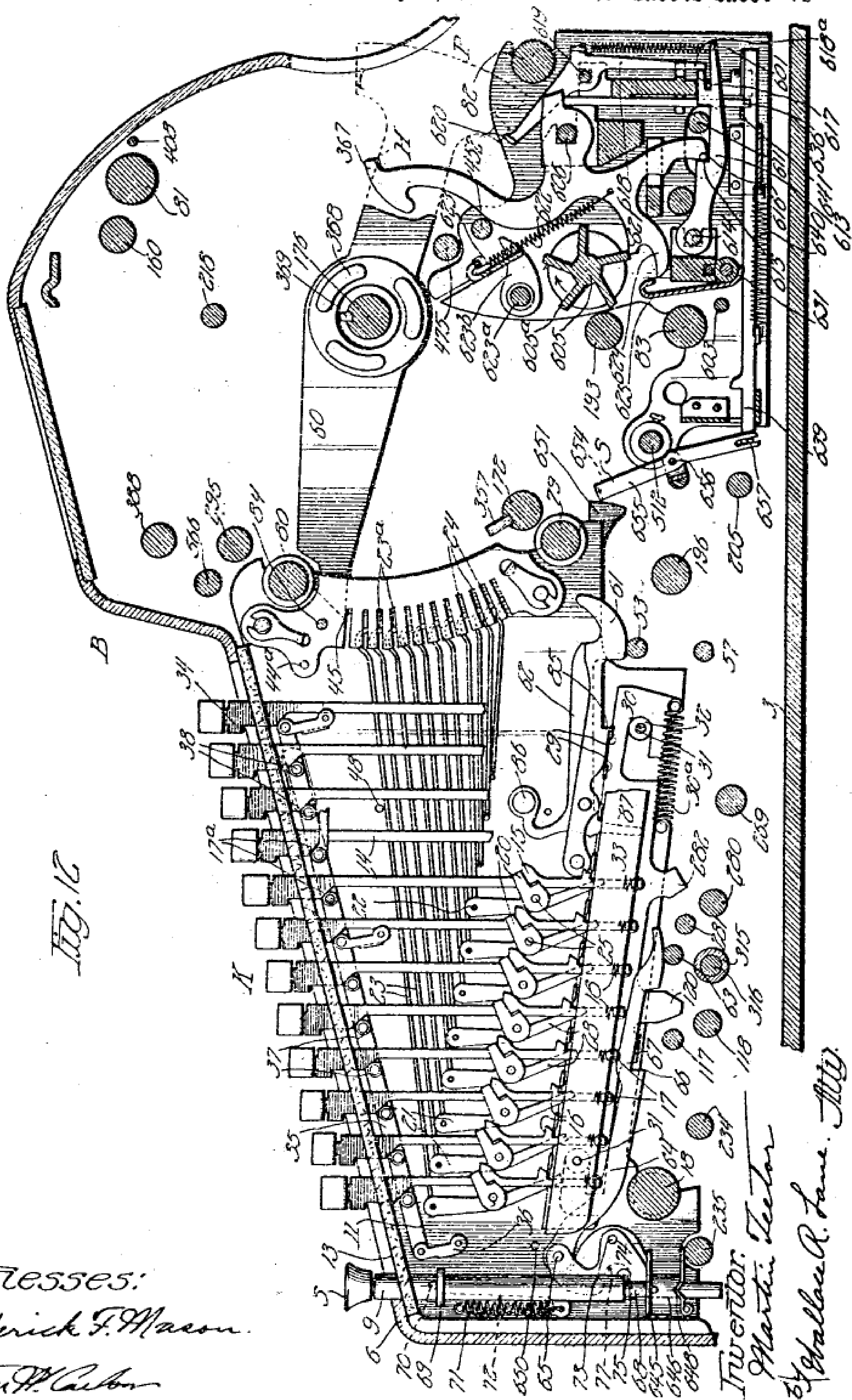
1925 10 27 US1558947 p11.png

Oct. 27, 1925. **1,558,947**

M. TEETOR

CALCULATING MACHINE

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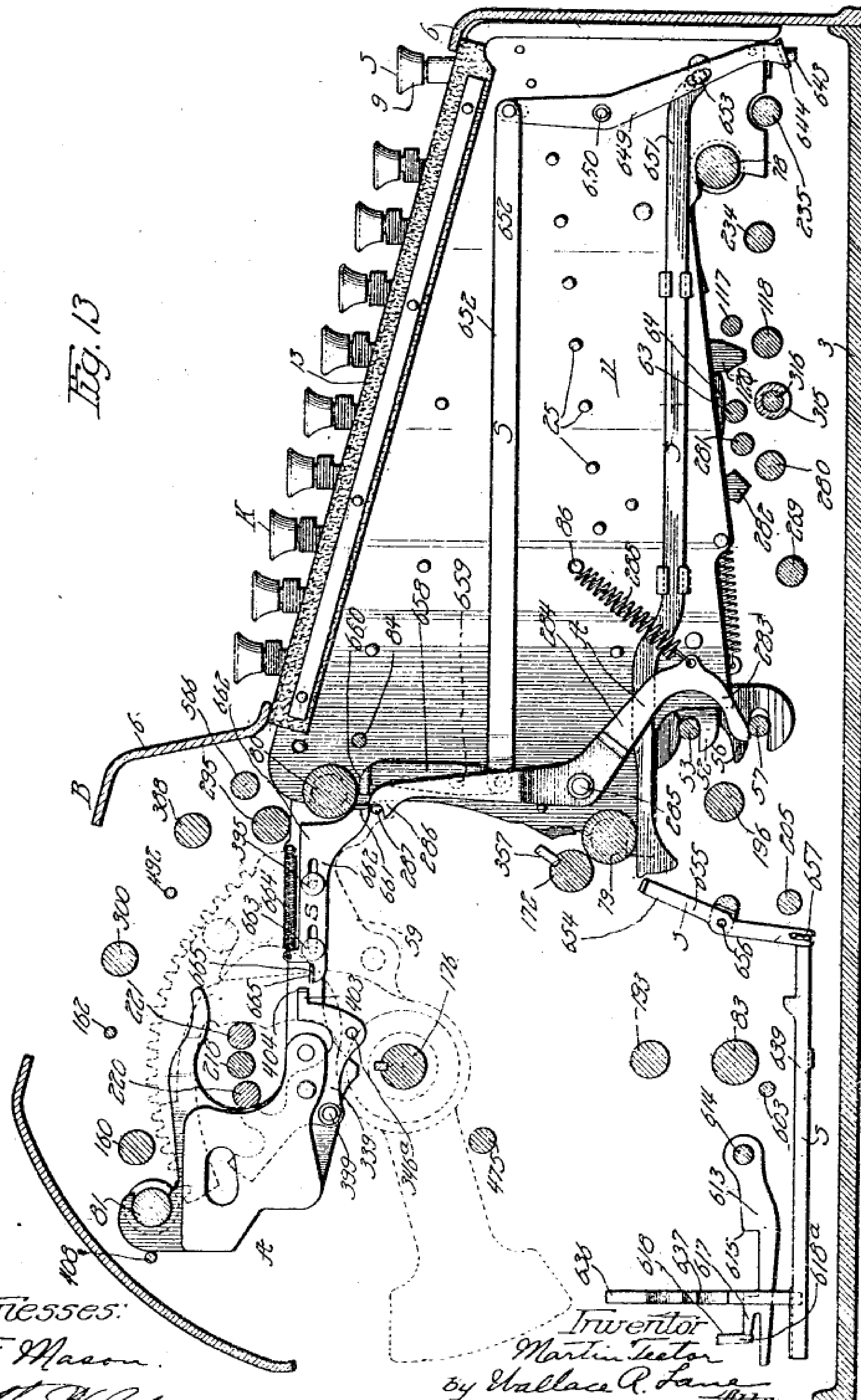
Witnesses:
Frederick F. Mason

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 13



Witnesses:
F. F. Mason
Arthur W. Carlson

Inventor
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p13.png

Oct. 27, 1925.

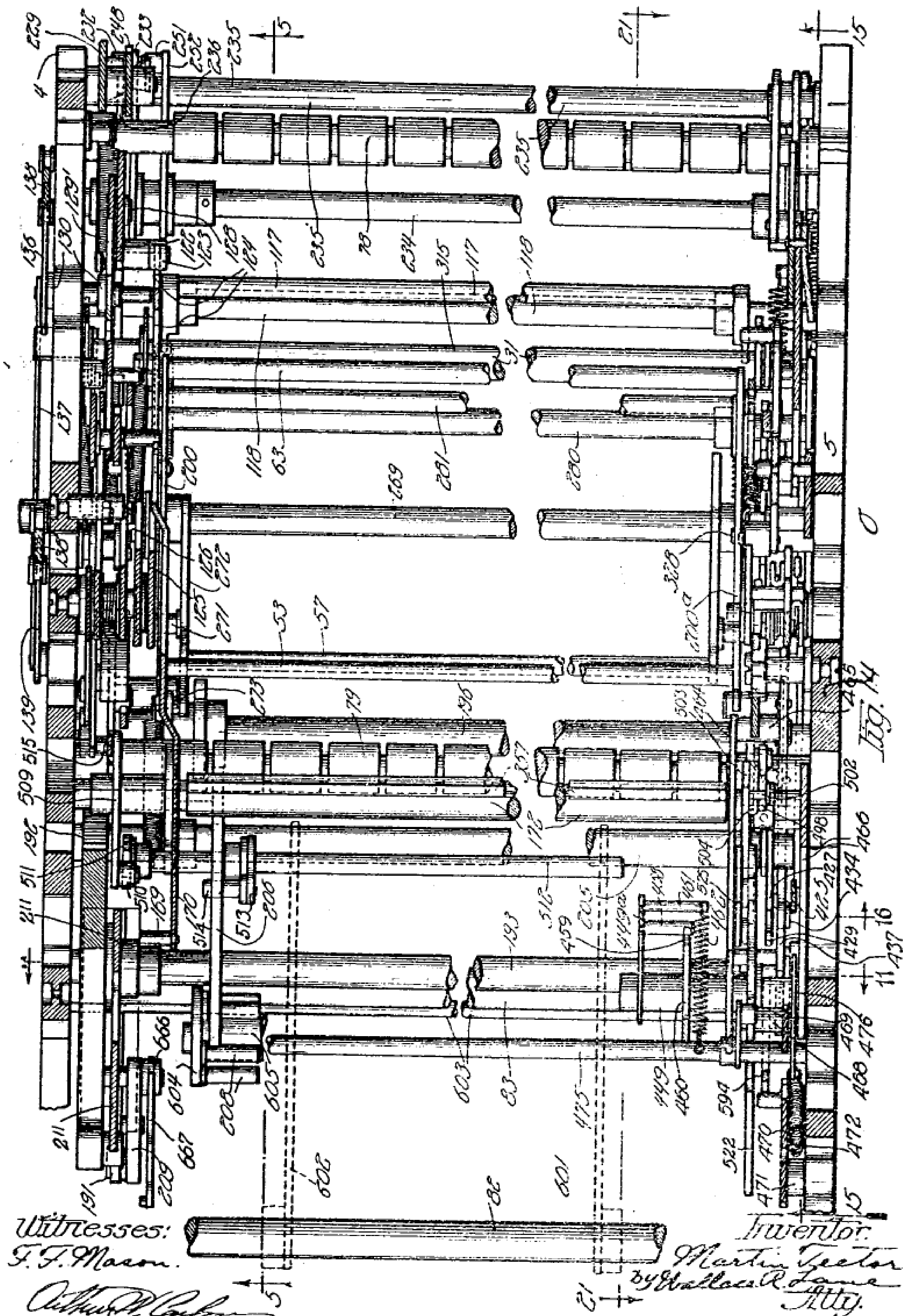
M. TEETOR

1,558,947

CALCULATING MACHINE

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59 Sheets-Sheet 14



Witnesses:
F. F. Mason.
Arthur W. Carlson

Inventor.
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p14.png

Oct. 27, 1925.

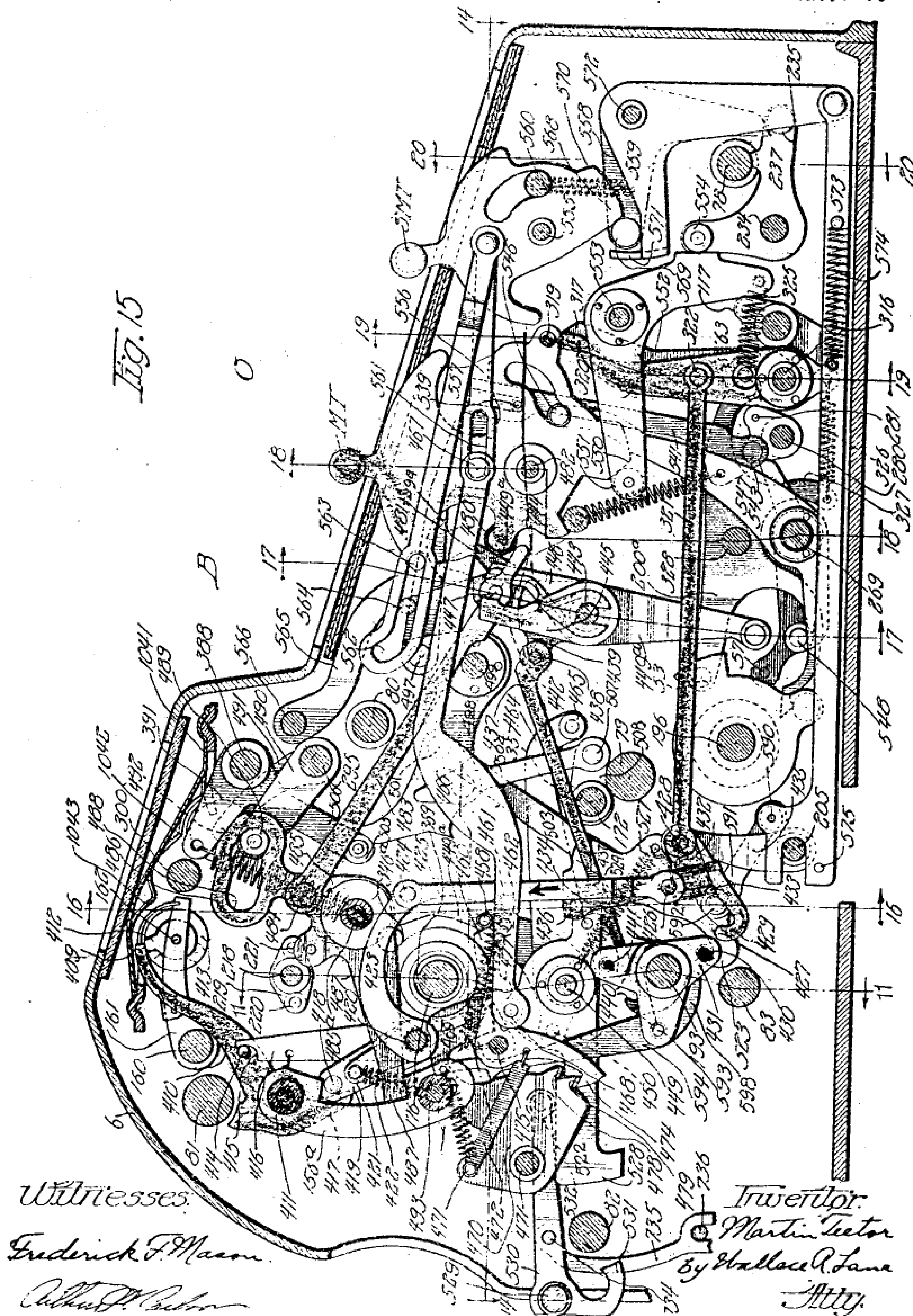
1,558,947

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CALCULATING MACHINE

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59 Sheets-Sheet 15



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Oct. 27, 1925.

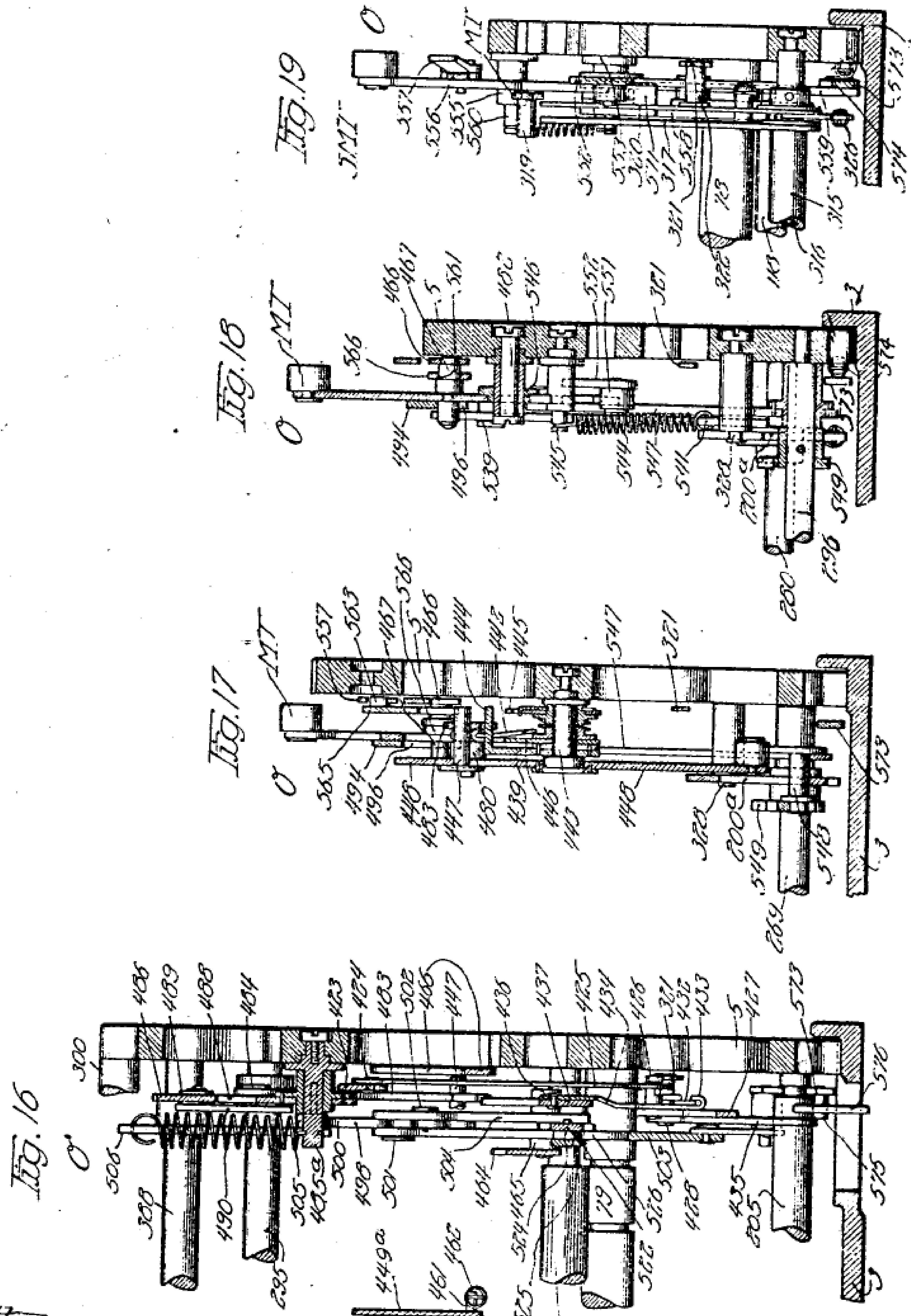
M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

1,558,947

59 Sheets-Sheet 16



Witnesses:
Frederick F. Mason.
Arthur R. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty

1925 10 27 US1558947 p16.png

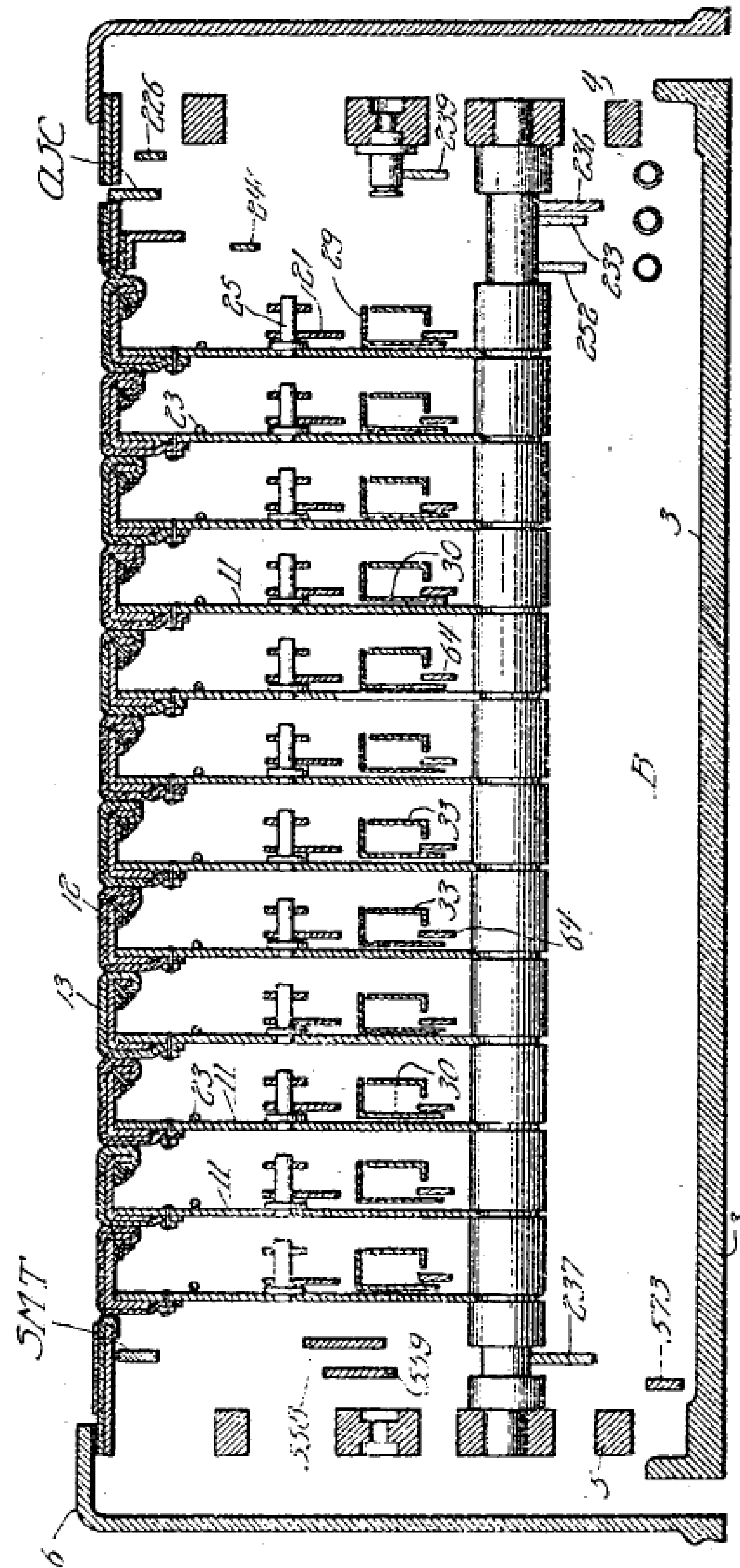
Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

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Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p17.png

Oct. 27, 1925.

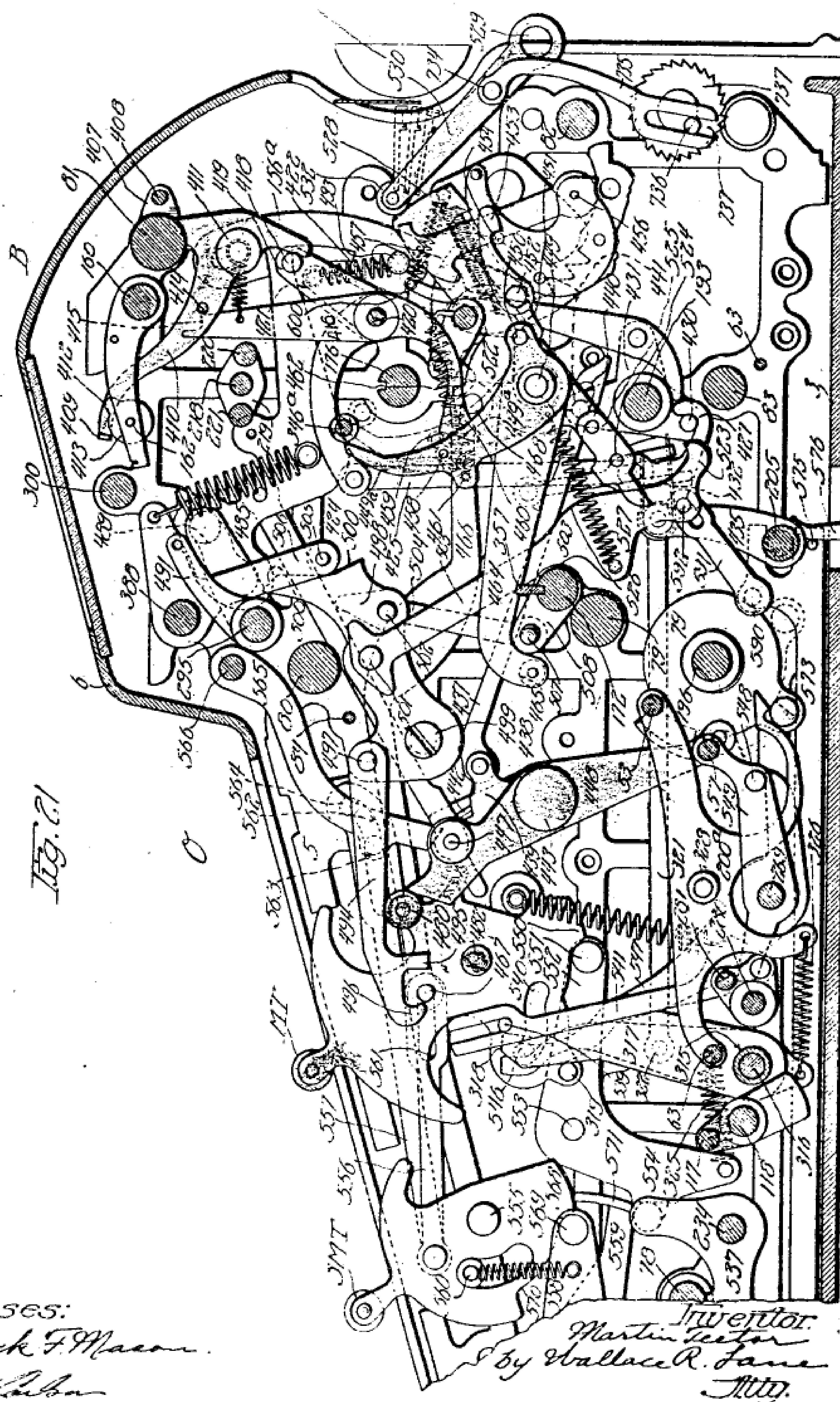
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 18



Witnesses:
Frederick F. Mason
Arthur H. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p18.png

Oct. 27, 1925.

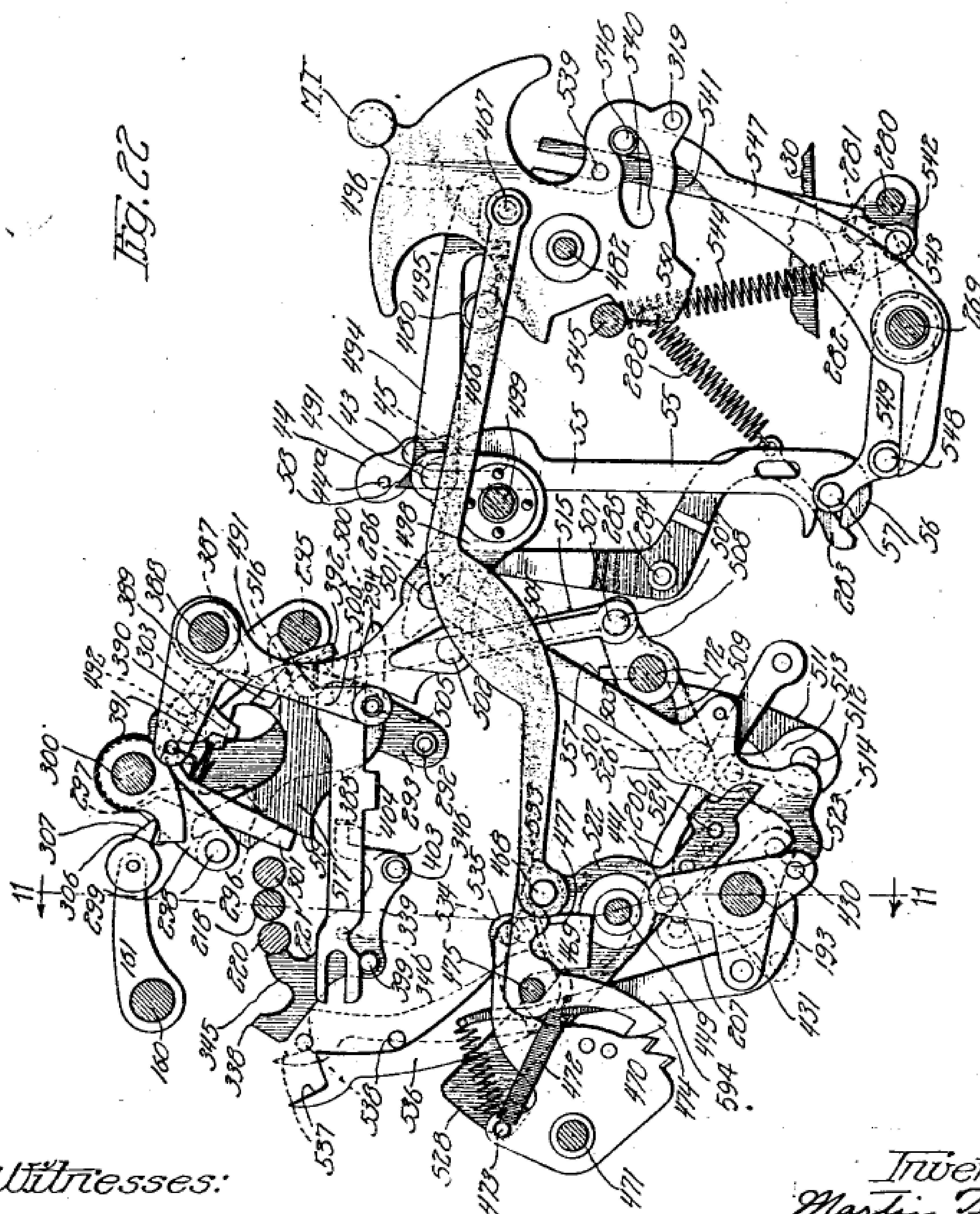
1,558,947

M. TEETOR

CALCULATING MACHINE

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59 Sheets-Sheet 19



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
By Wallace R. Lane
Atty.

1925 10 27 US1558947 p19.png

Oct. 27, 1925.

1,558,947

M. TEETOR

CALCULATING MACHINE

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59 Sheets-Sheet 20

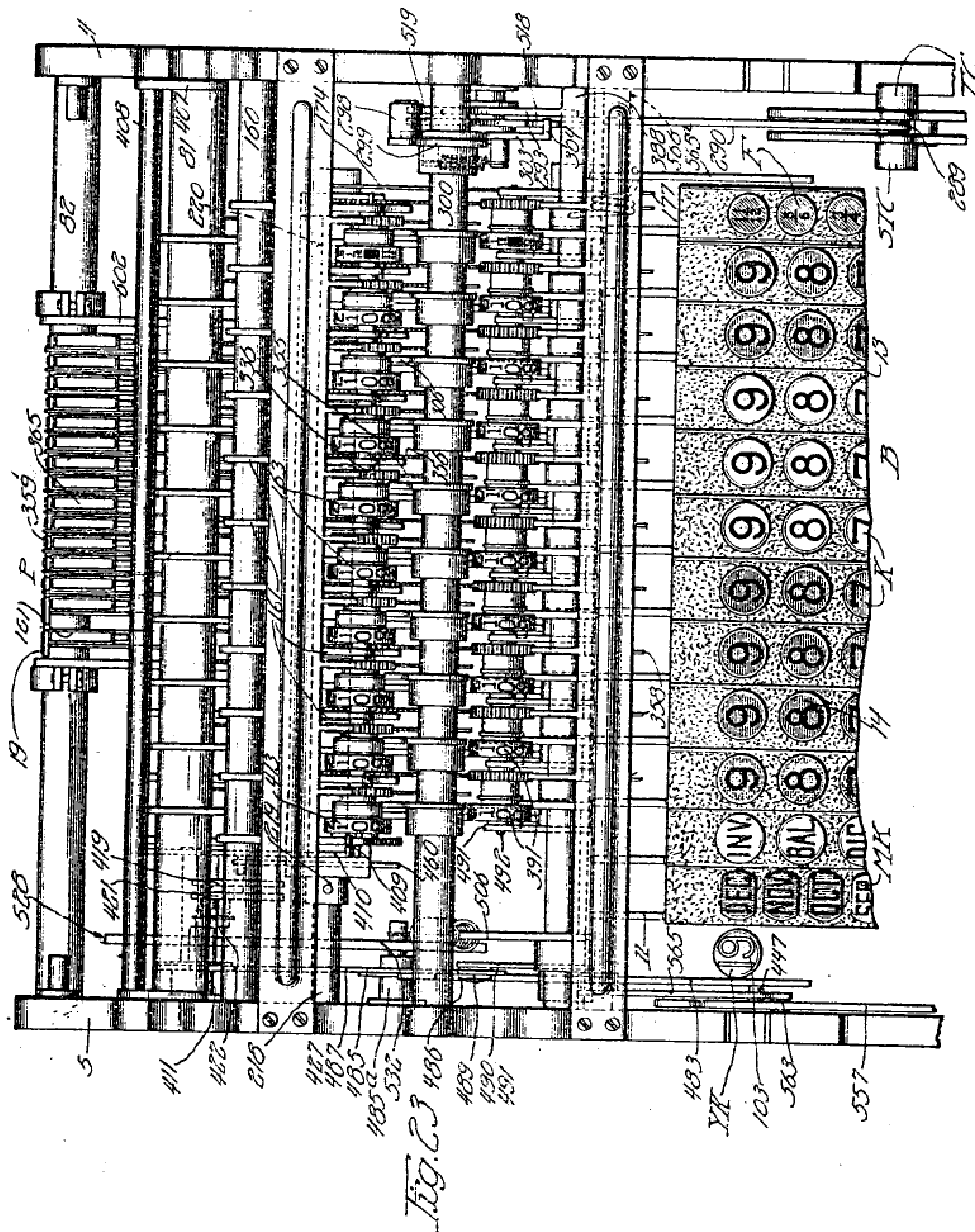


Fig. 23

Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p20.png

Oct. 27, 1925.

1,558,947

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59 Sheets-Sheet 21

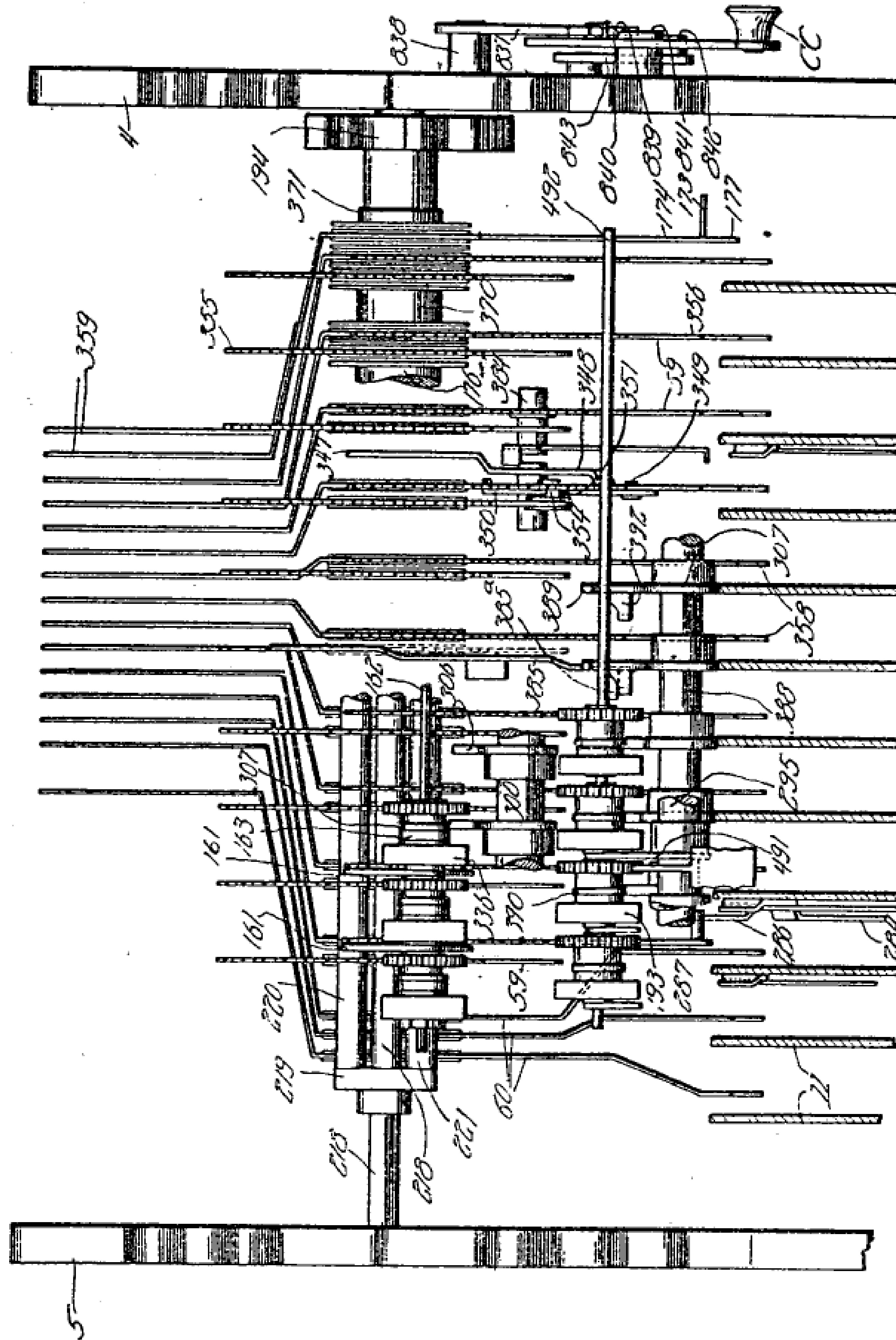


Fig. 24

Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p21.png

Oct. 27, 1925.

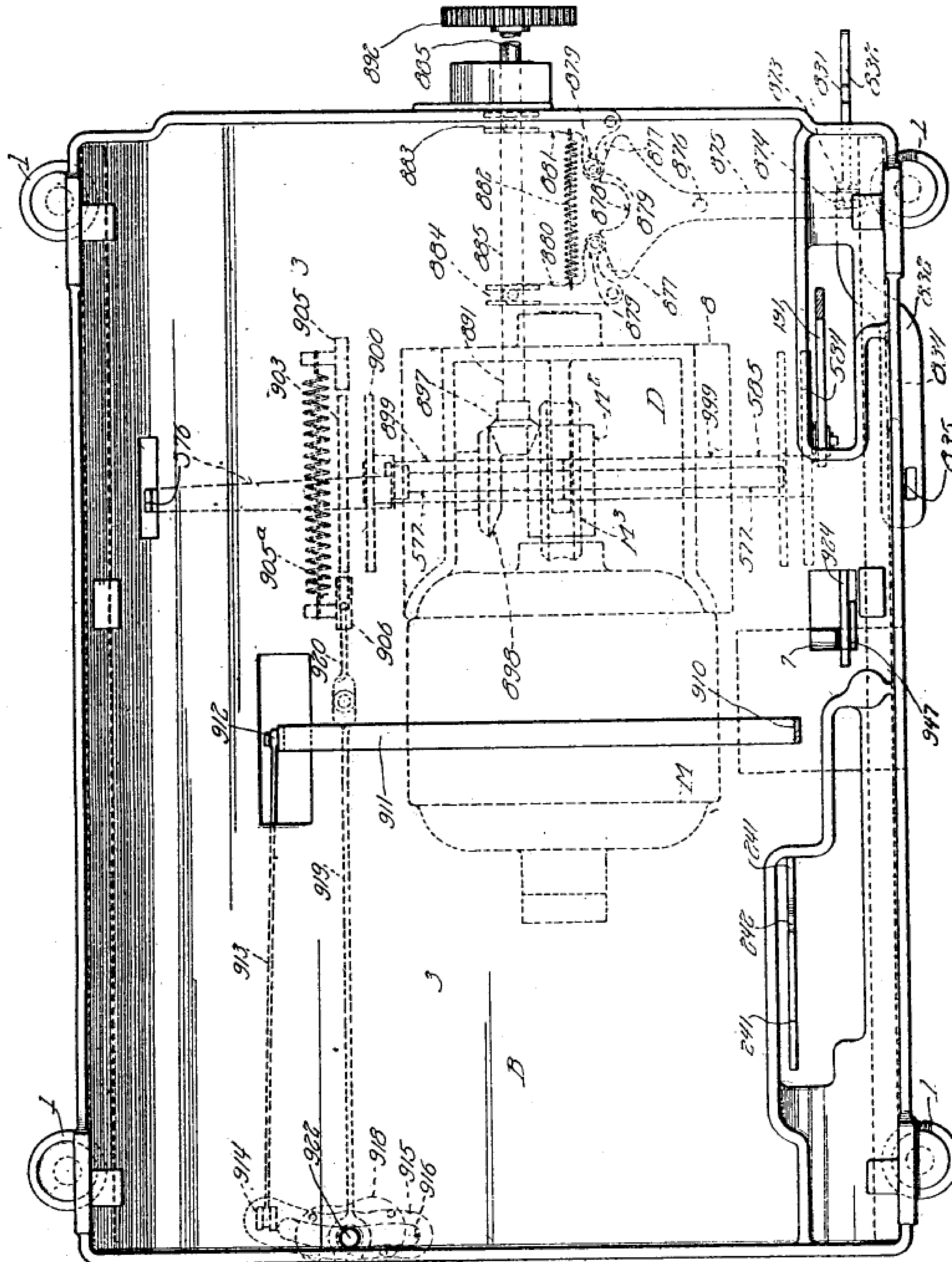
1,558,947

M. TEETOR

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59 Sheets-Sheet 22



Witnesses:
Frederick F. Mason.
Arthur M. Carlson

Fig. 25

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p22.png

Oct. 27, 1925.

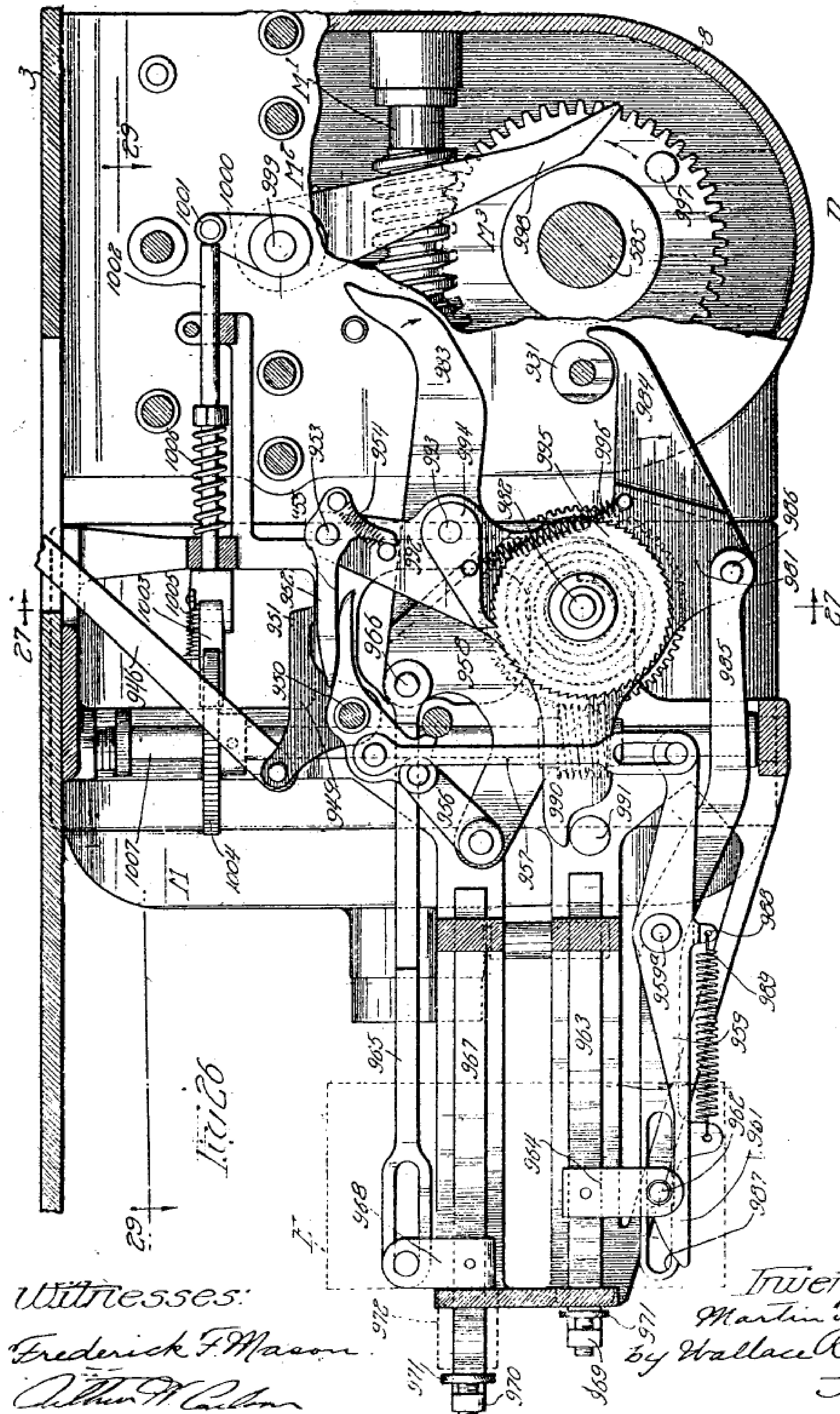
1,558,947

M. TEETOR

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59 Sheets-Sheet 23



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor.
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p23.png

Oct. 27, 1925.

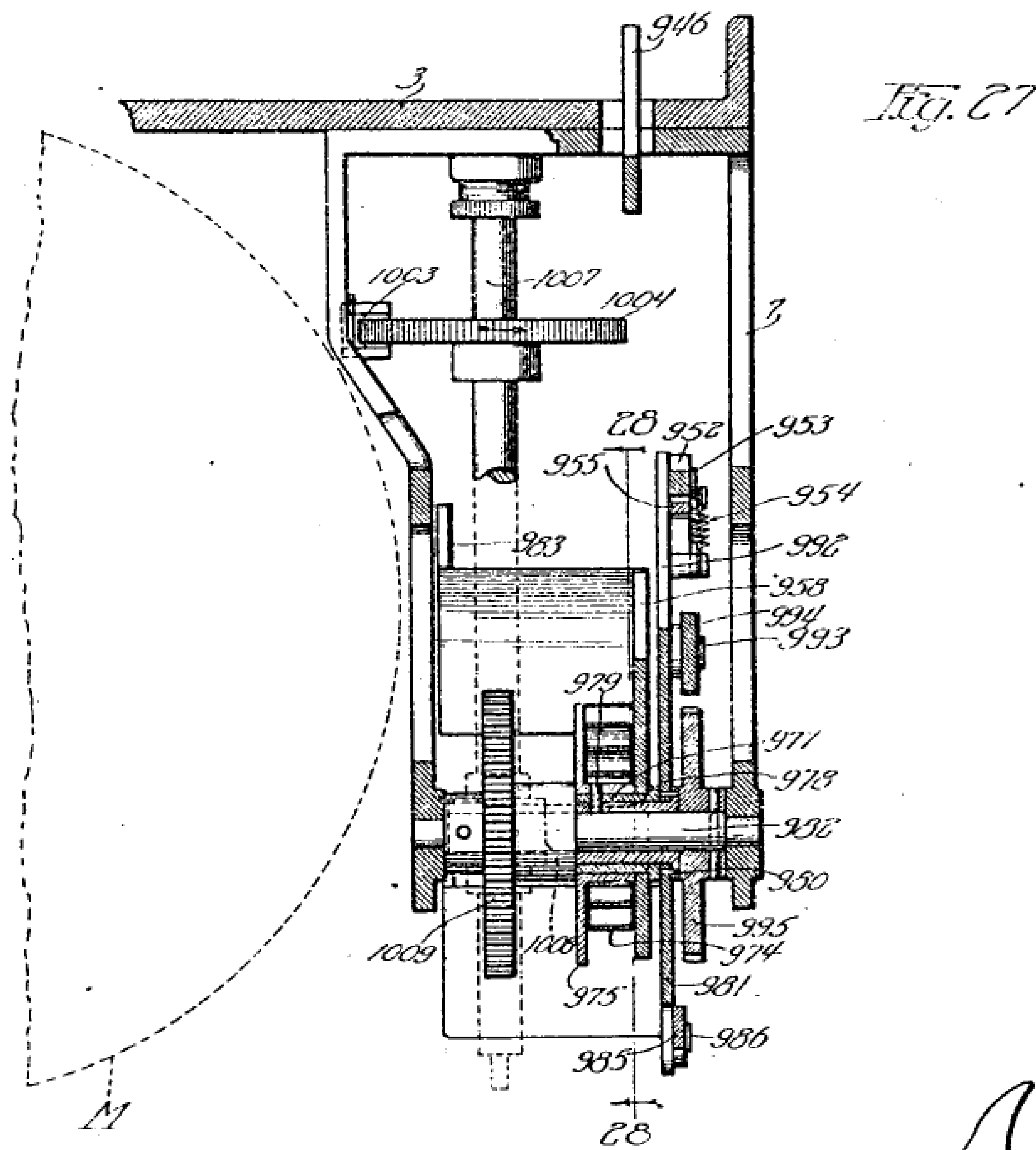
1,558,947

M. TEETOR

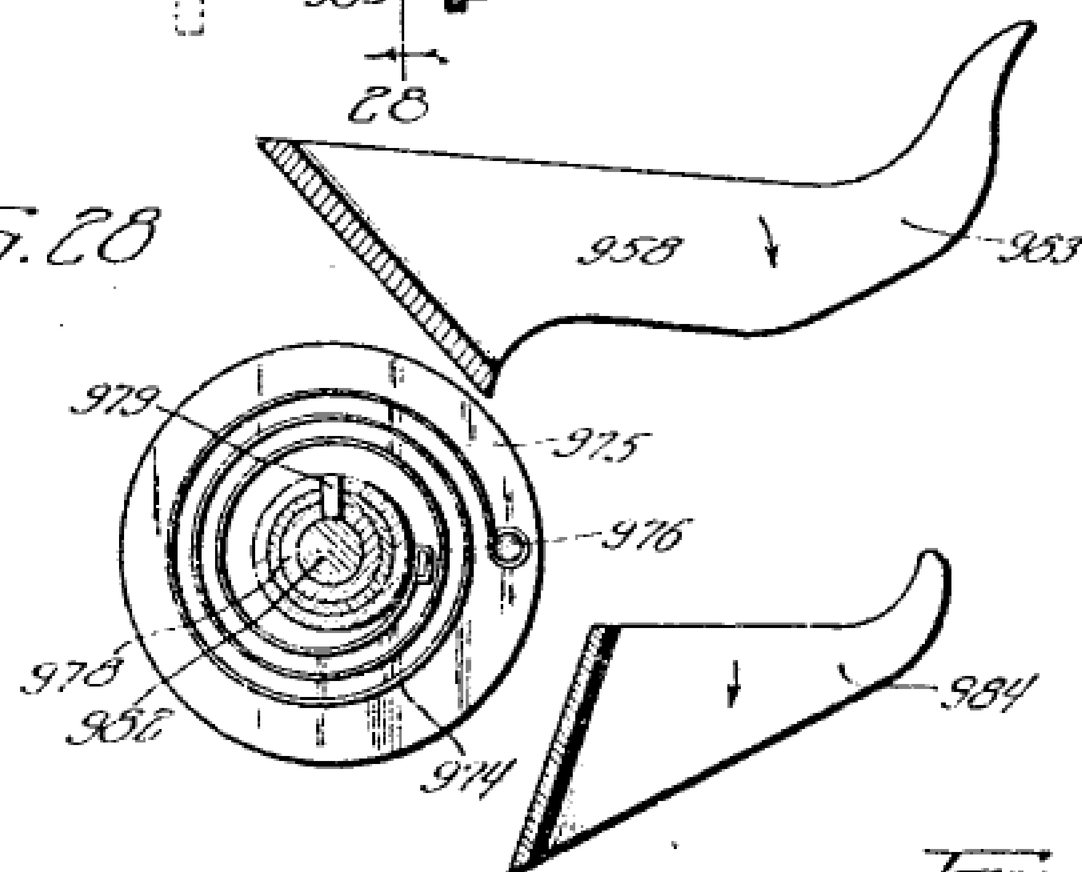
CALCULATING MACHINE

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59 Sheets-Sheet 24







Witnesses:
Frederick F. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

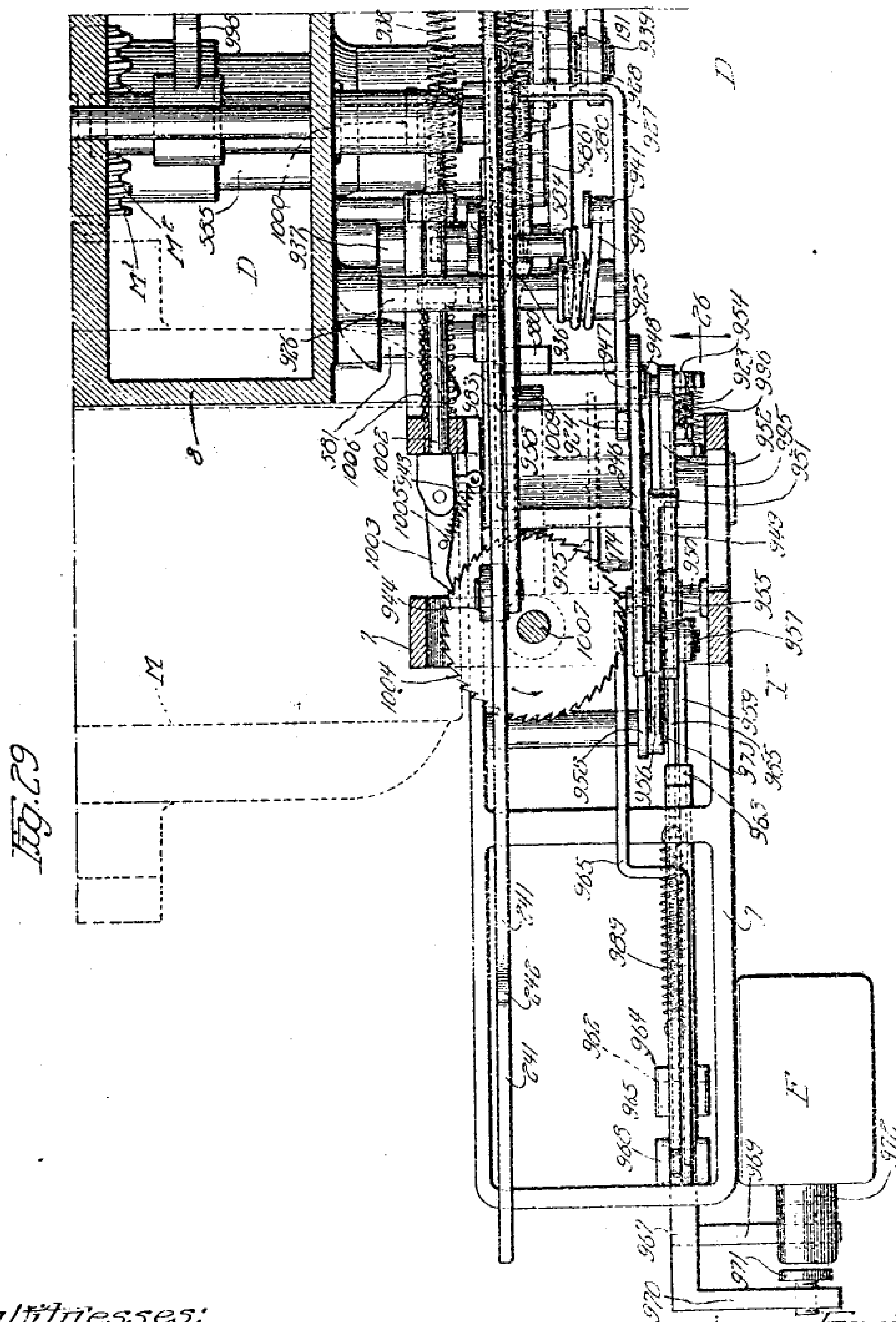
1925 10 27 US1558947 p24.png

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

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Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane Atty.

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Oct. 27, 1925.

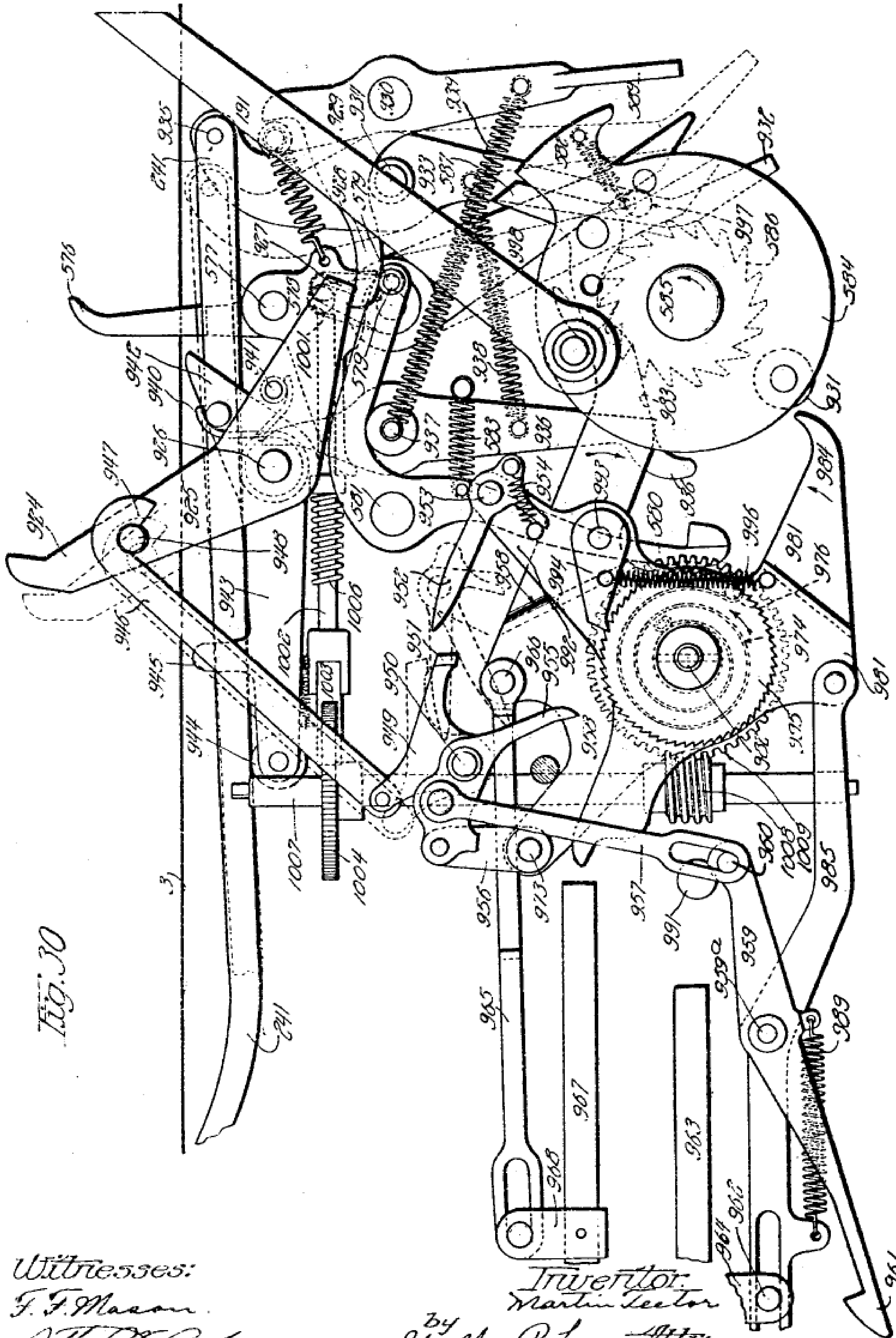
1,558,947

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59 Sheets-Sheet 26



Witnesses:
F. F. Mason
Arthur R. Carlson

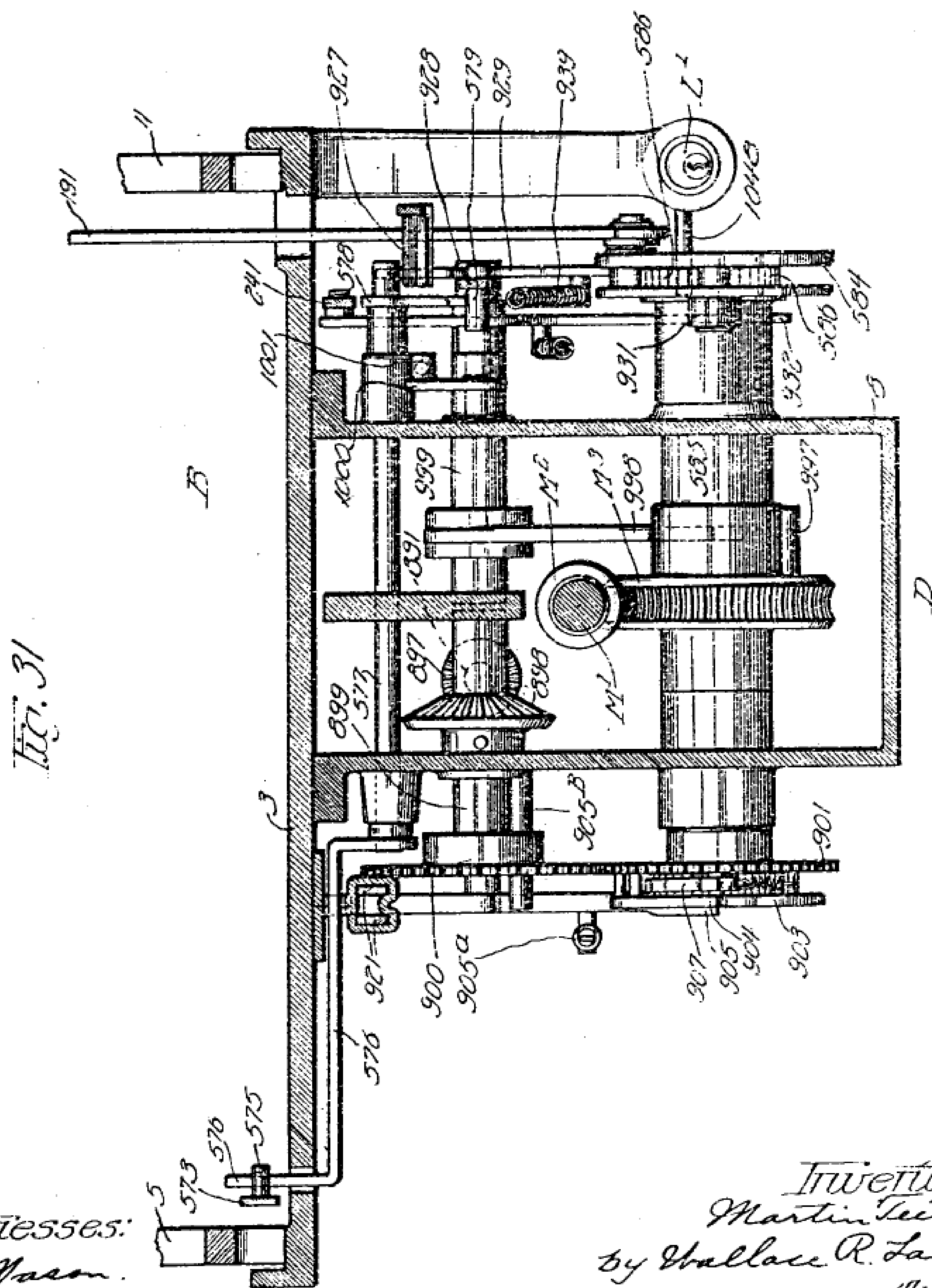
Inventor:
Martin Teetor
by Wallace R. Lane Atty.

1925 10 27 US1558947 p26.png

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920   59 Sheets-Sheet 27



Witnesses:
F. F. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

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Oct. 27, 1925.

1,558,947

M. TEETOR

CALCULATING MACHINE

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59 Sheets-Sheet 28

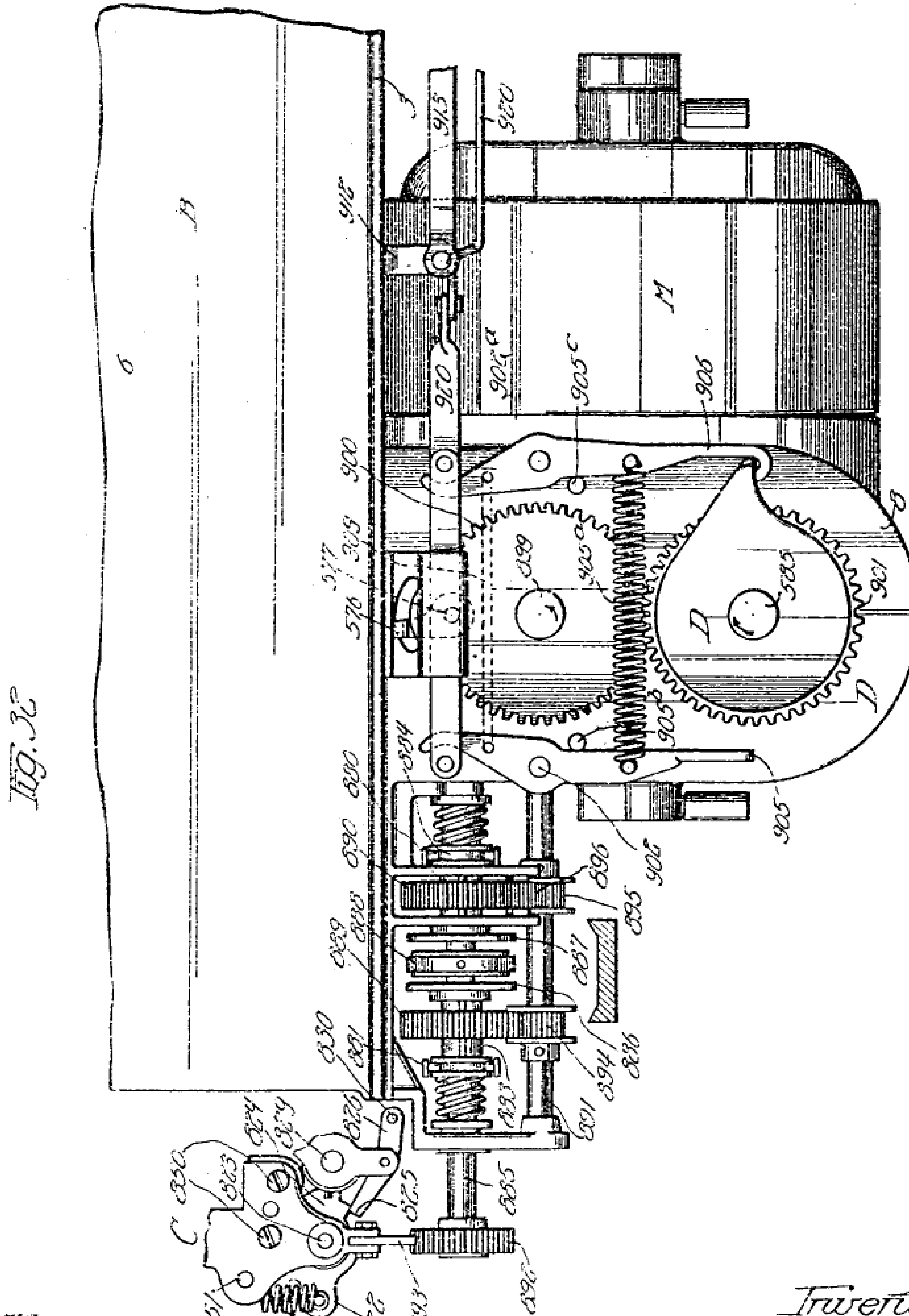


Fig. 32

Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

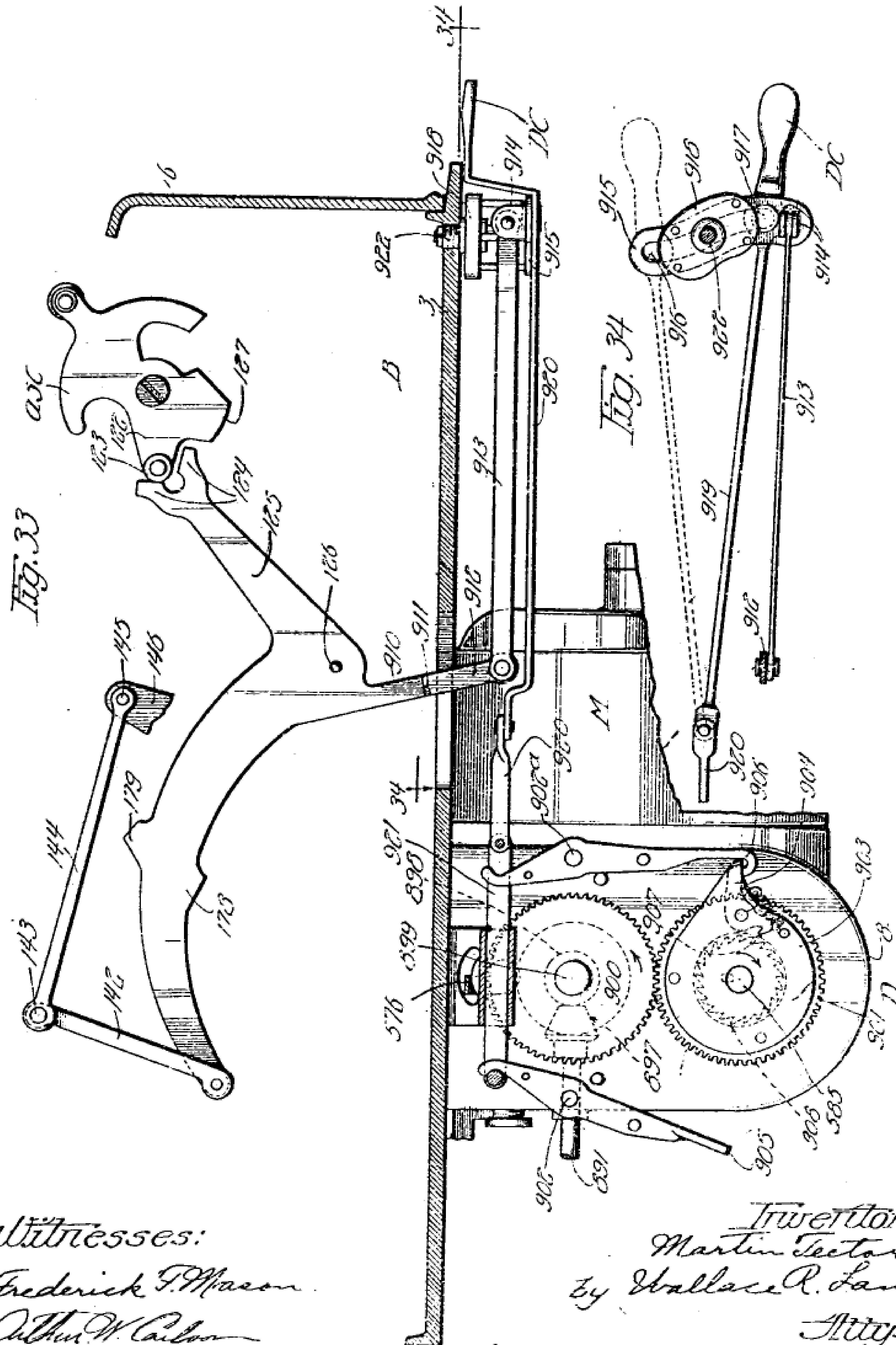
1925 10 27 US1558947 p28.png

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

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Witnesses:
Frederick F. Mason
Arthur W. Carlson

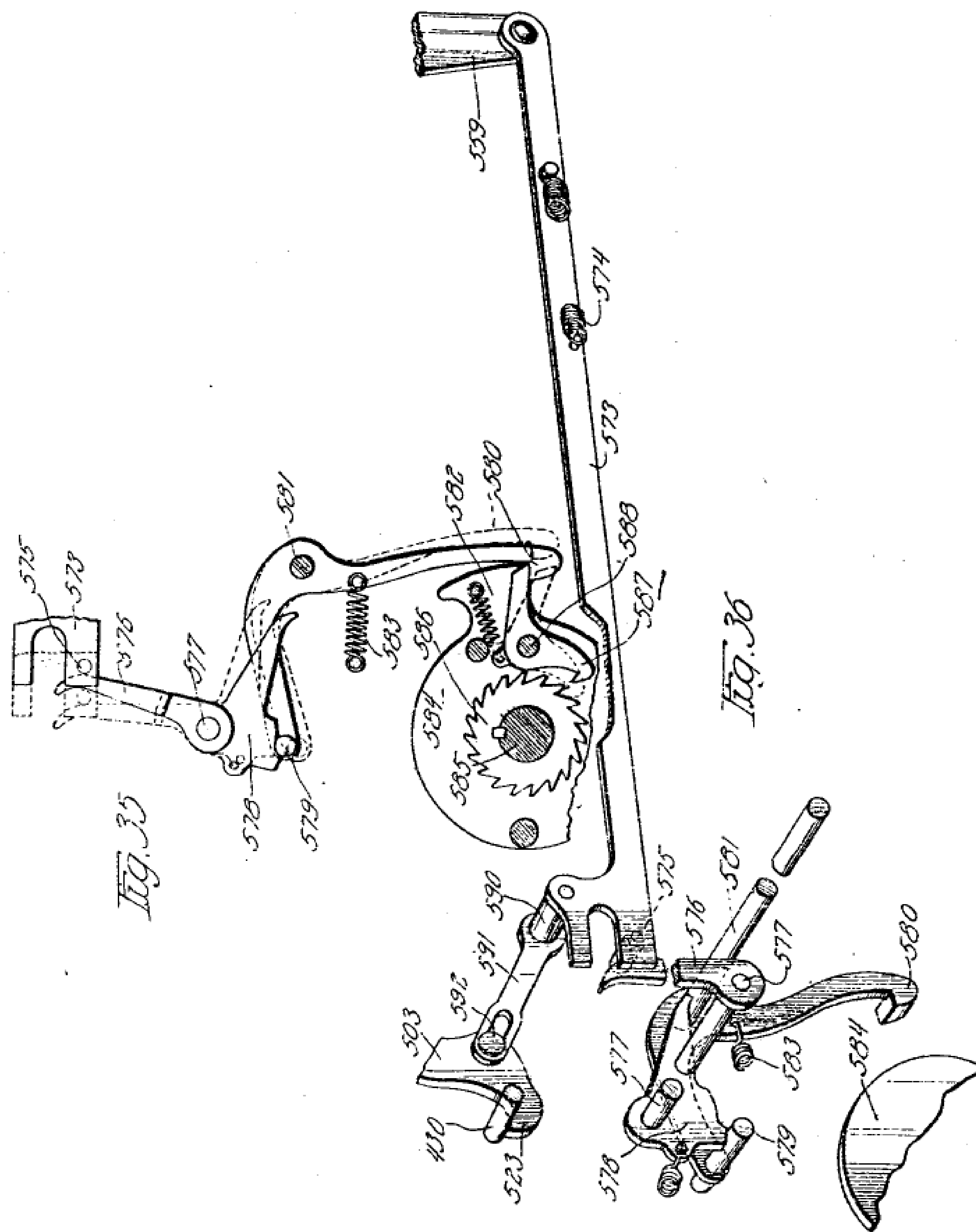
Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p29.png

M. TEETOR

CALCULATING MACHINE

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Witnesses:
Frederick F. Mason
Arthur W. Carlson

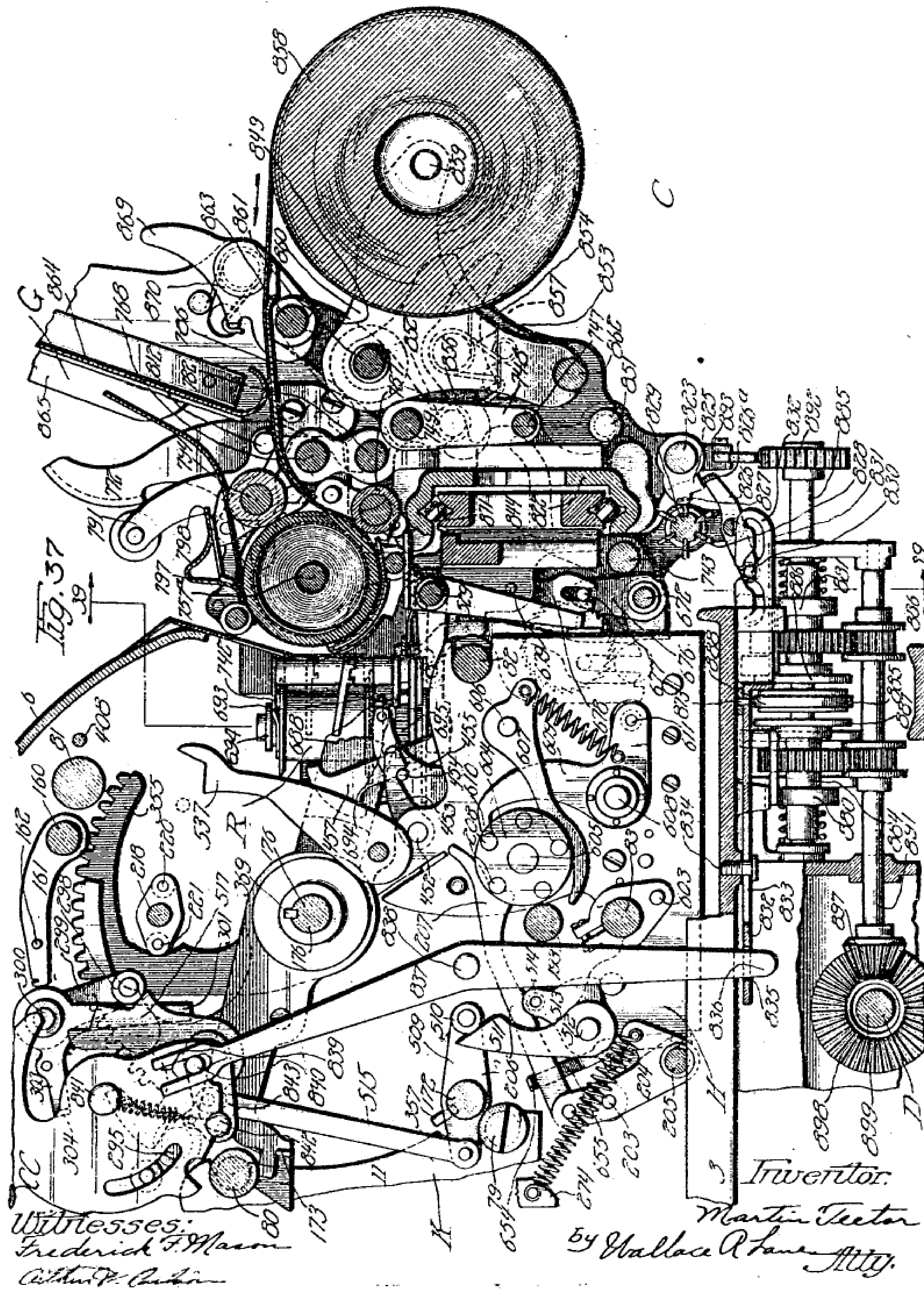
Inventor
Martin Teetor
by Wallace R. Lane
Atty.

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

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1925 10 27 US1558947 p31.png

Oct. 27, 1925.

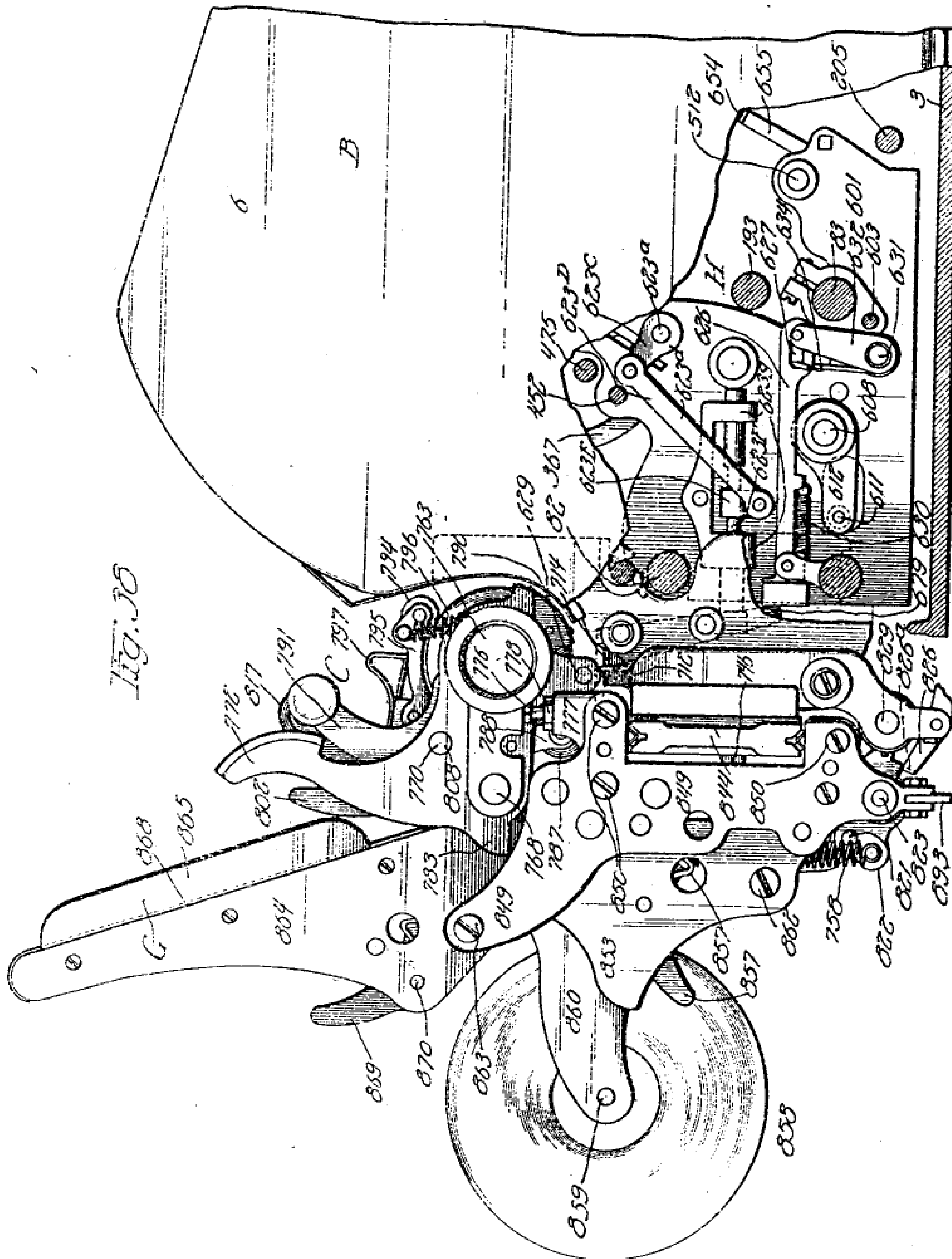
M. TEETOR

1,558,947

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 32



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p32.png

Oct. 27, 1925.

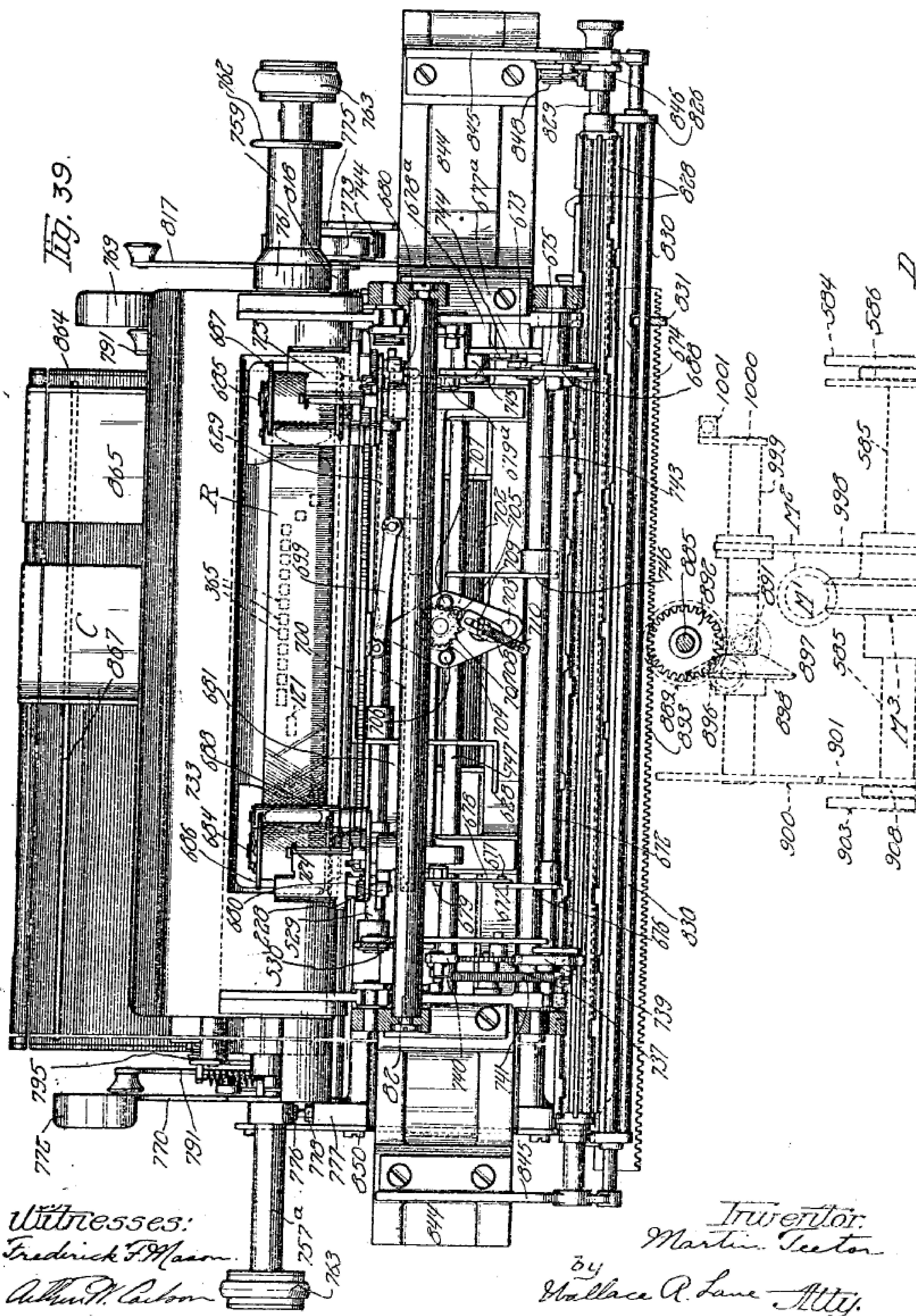
M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

1,558,947

59 Sheets-Sheet 33



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane Atty.

1925 10 27 US1558947 p33.png

Oct. 27, 1925.

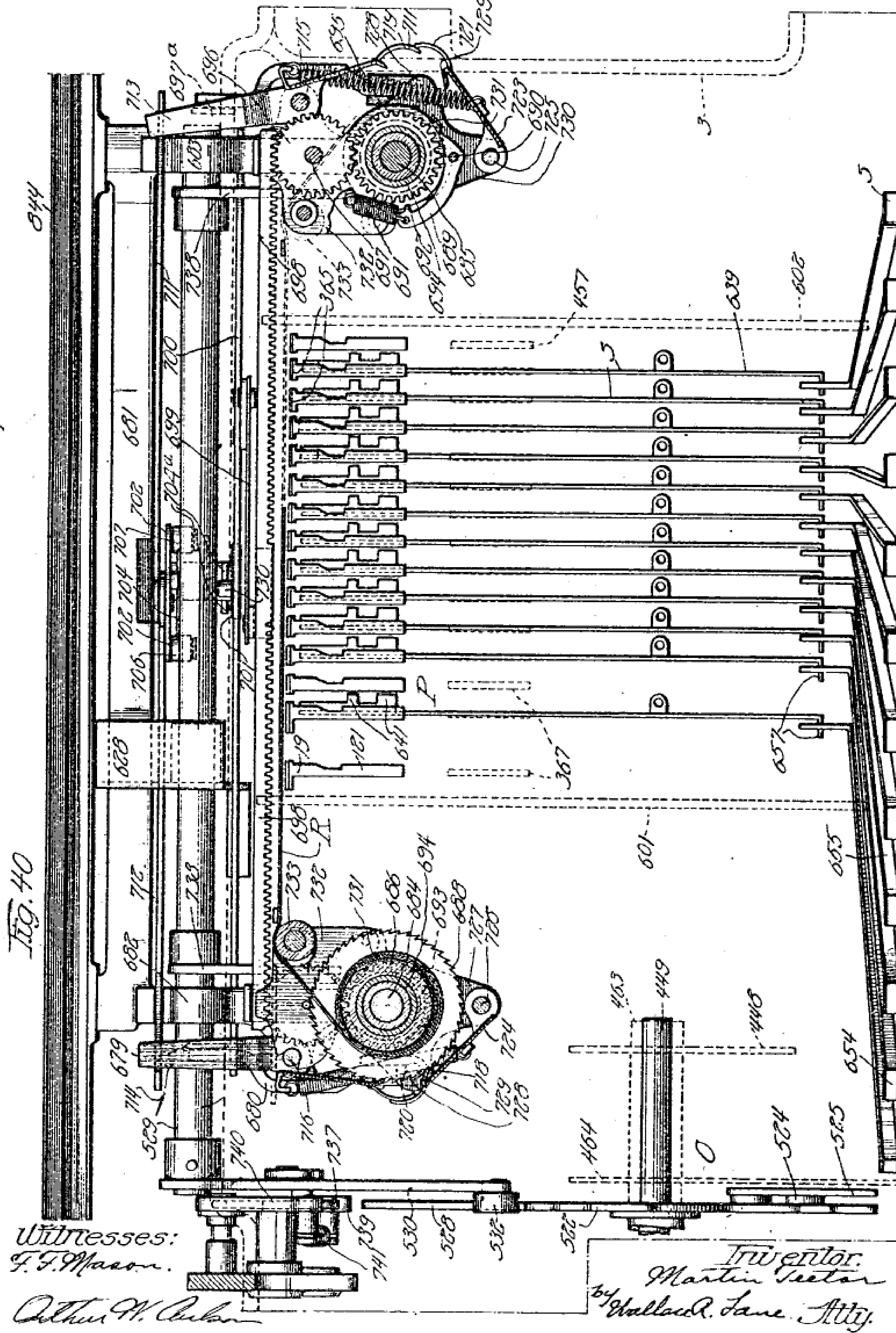
M. TEETOR

1,558,947

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 34



1925 10 27 US1558947 p34.png

Oct. 27, 1925.

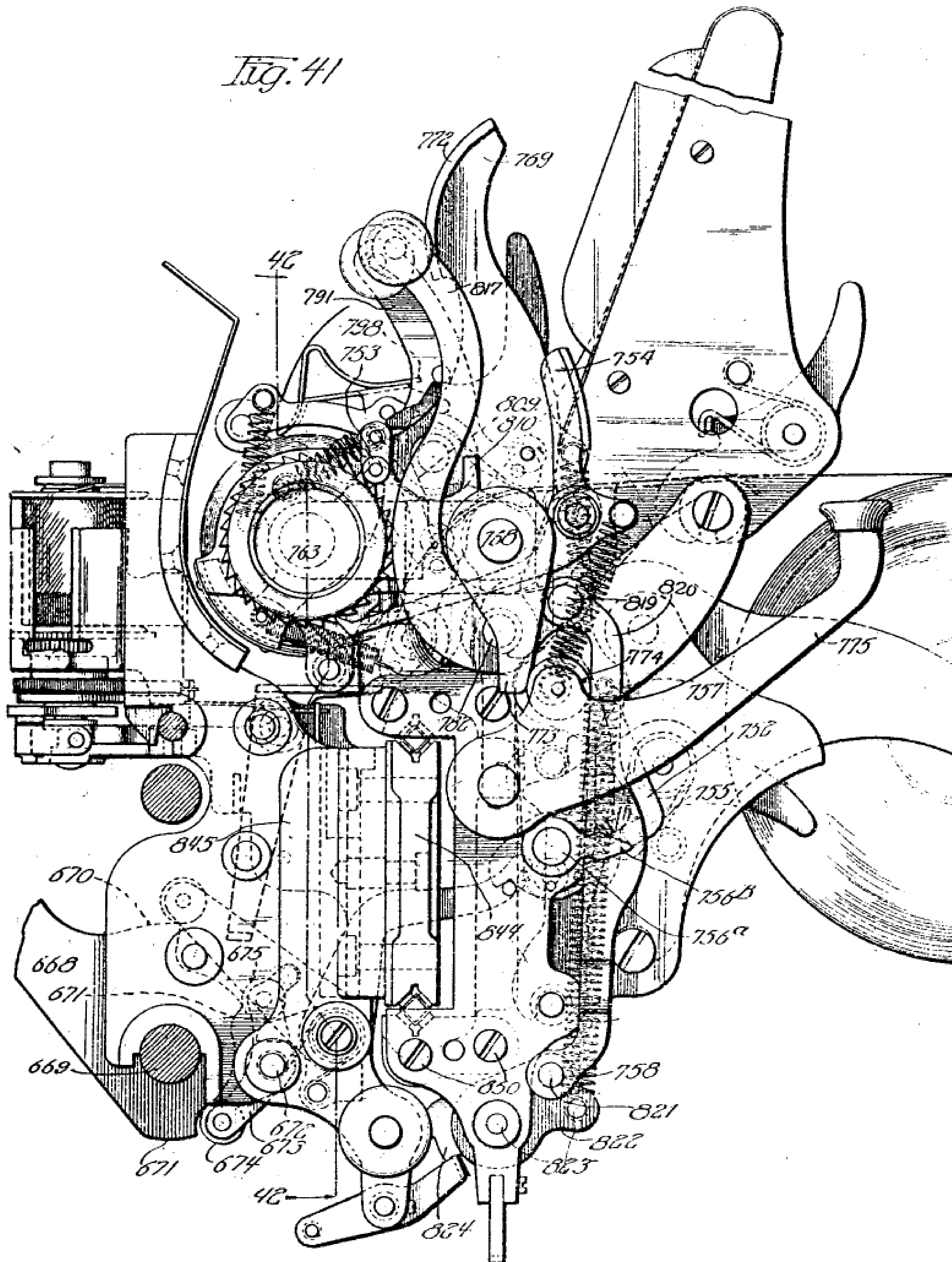
M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

1,558,947

59 Sheets-Sheet 35



Witnesses:
Frederick F. Mason.
Arthur W. [illegible]

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p35.png

Oct. 27, 1925.

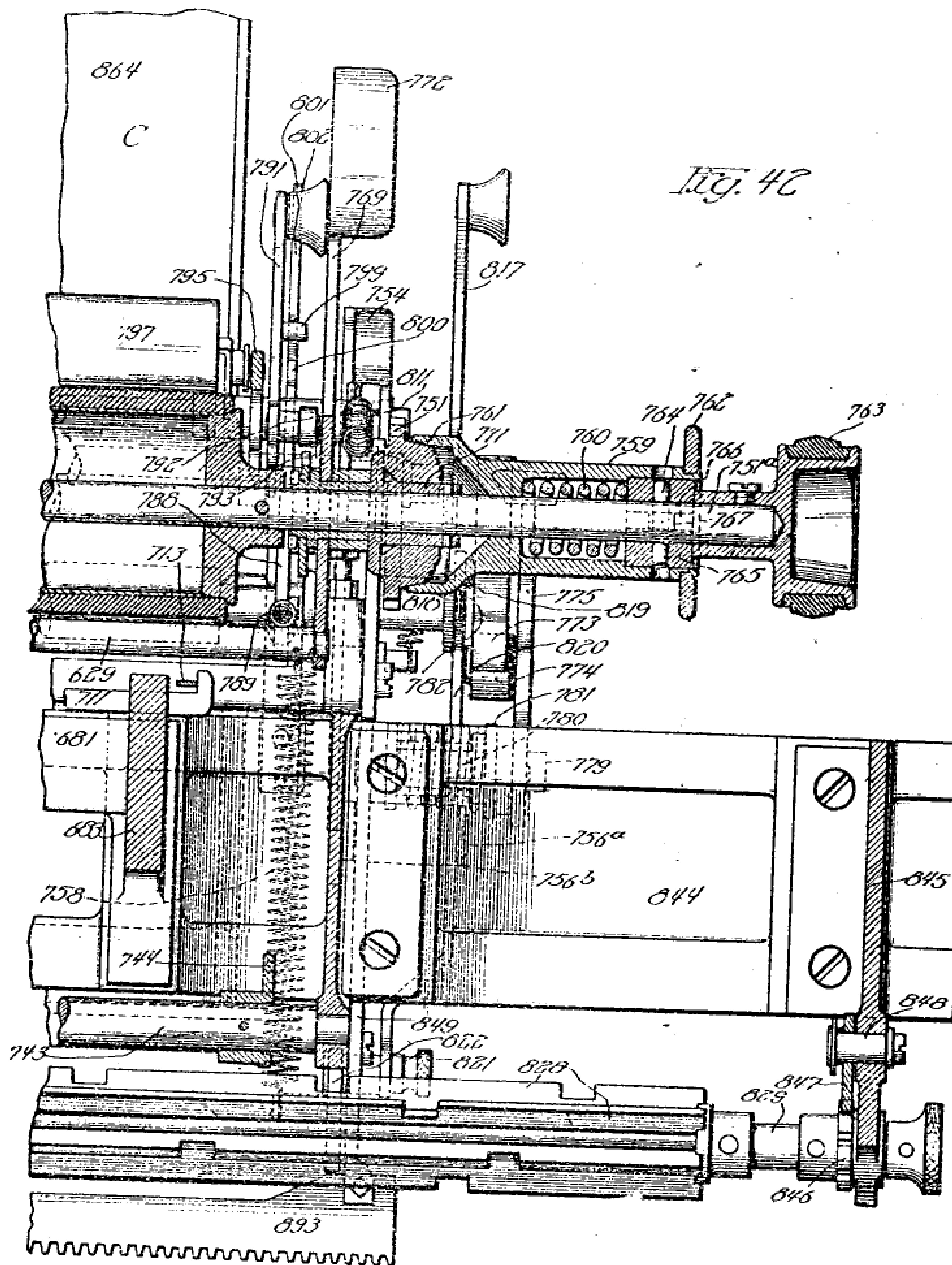
M. TEETOR

1,558,947

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 36



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor.
Martin Teetor
by Wallace R. Lane
Atty.

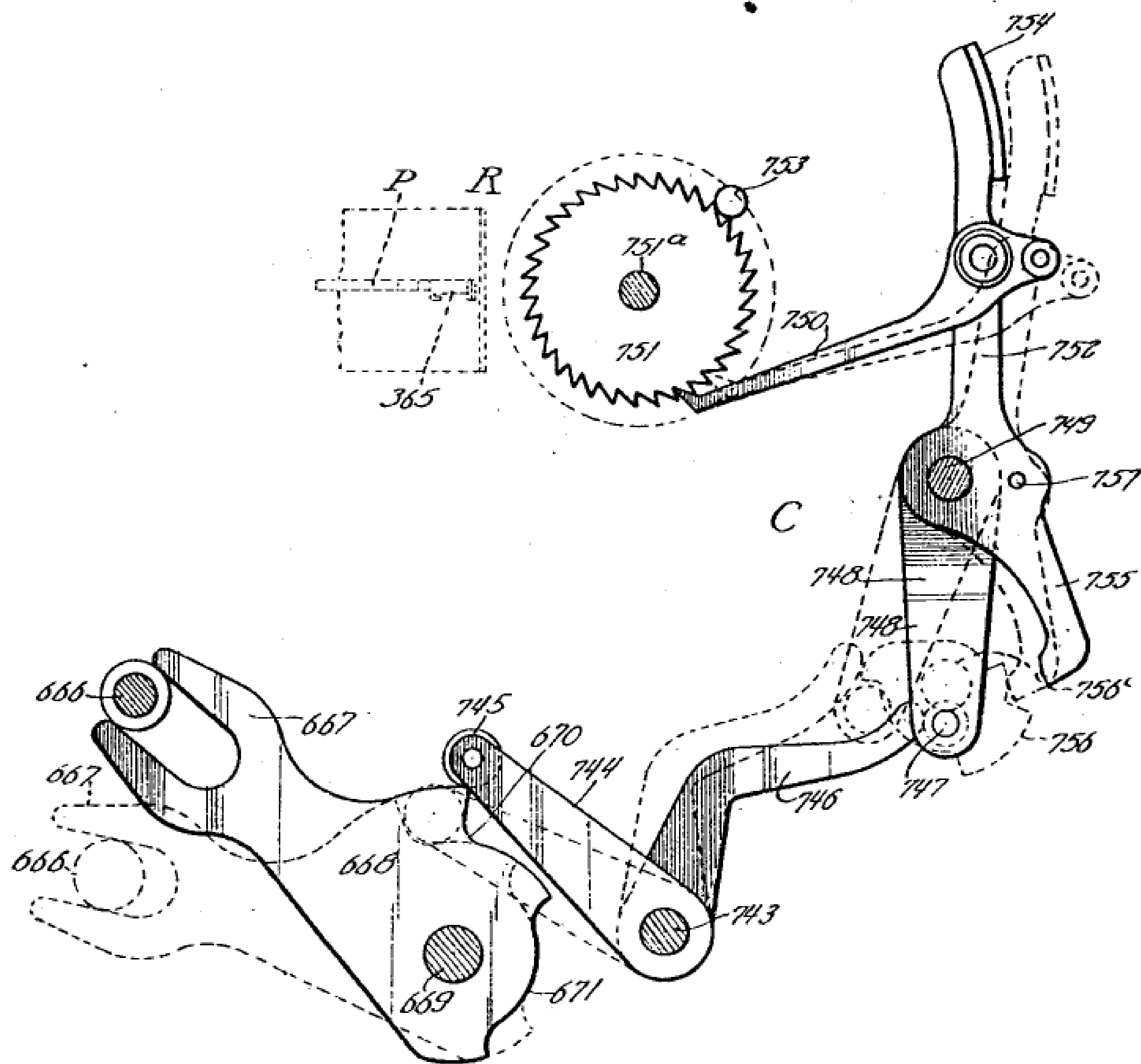
1925 10 27 US1558947 p36.png

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 37

Fig. 43



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

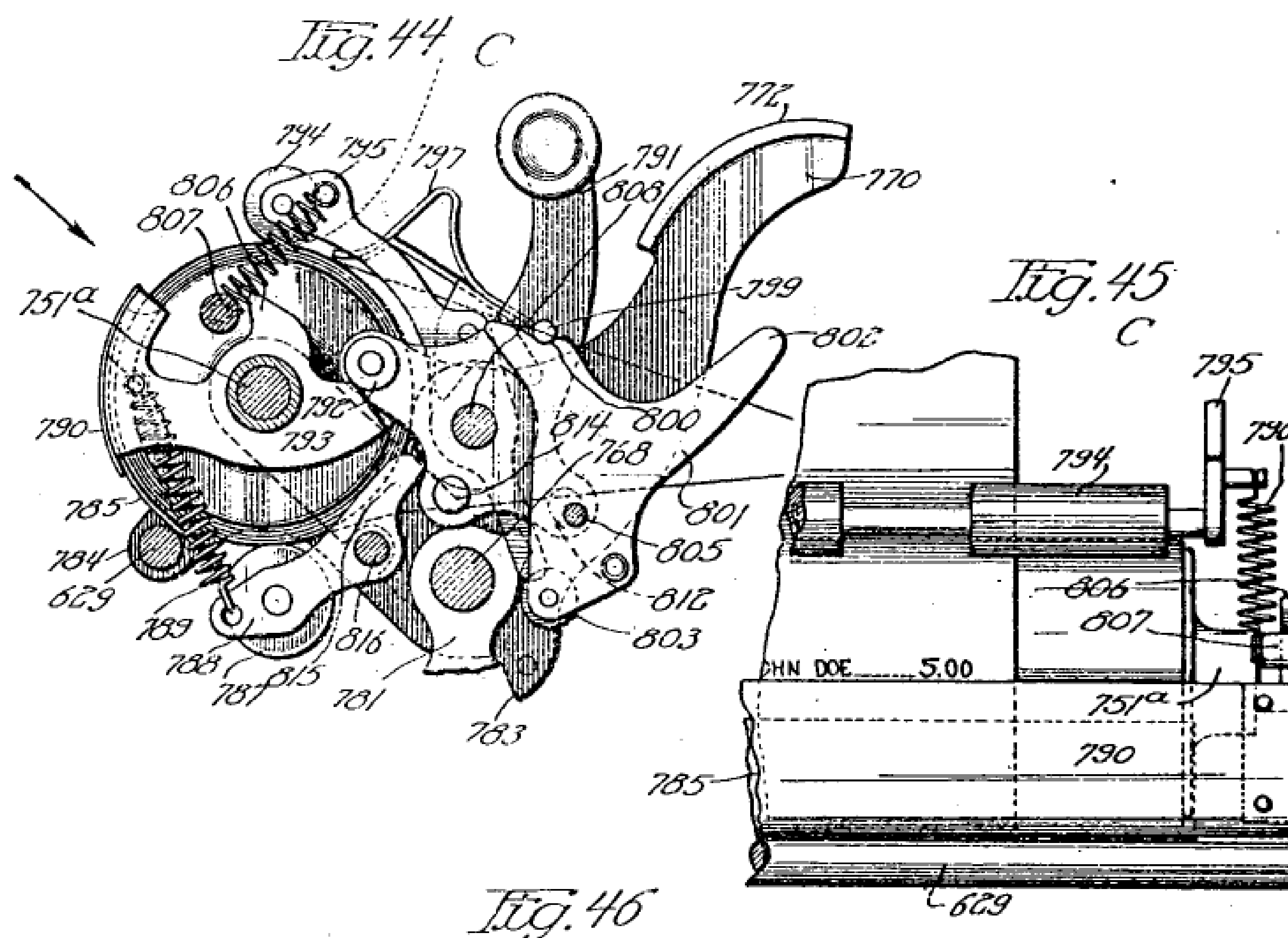
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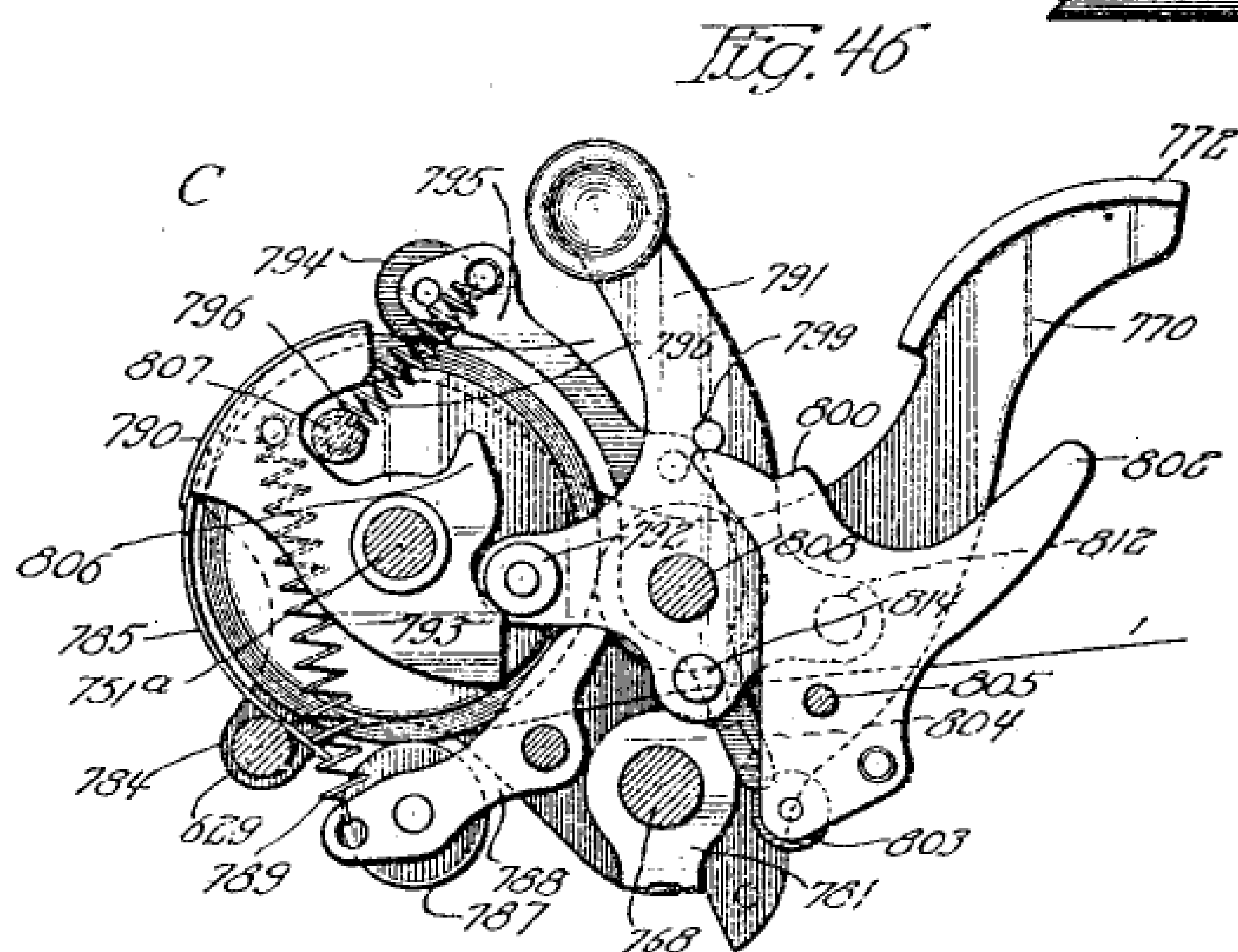
Oct. 27, 1925. **1,558,947**

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 38





Witnesses:
Frederick F. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 39

Fig. 47

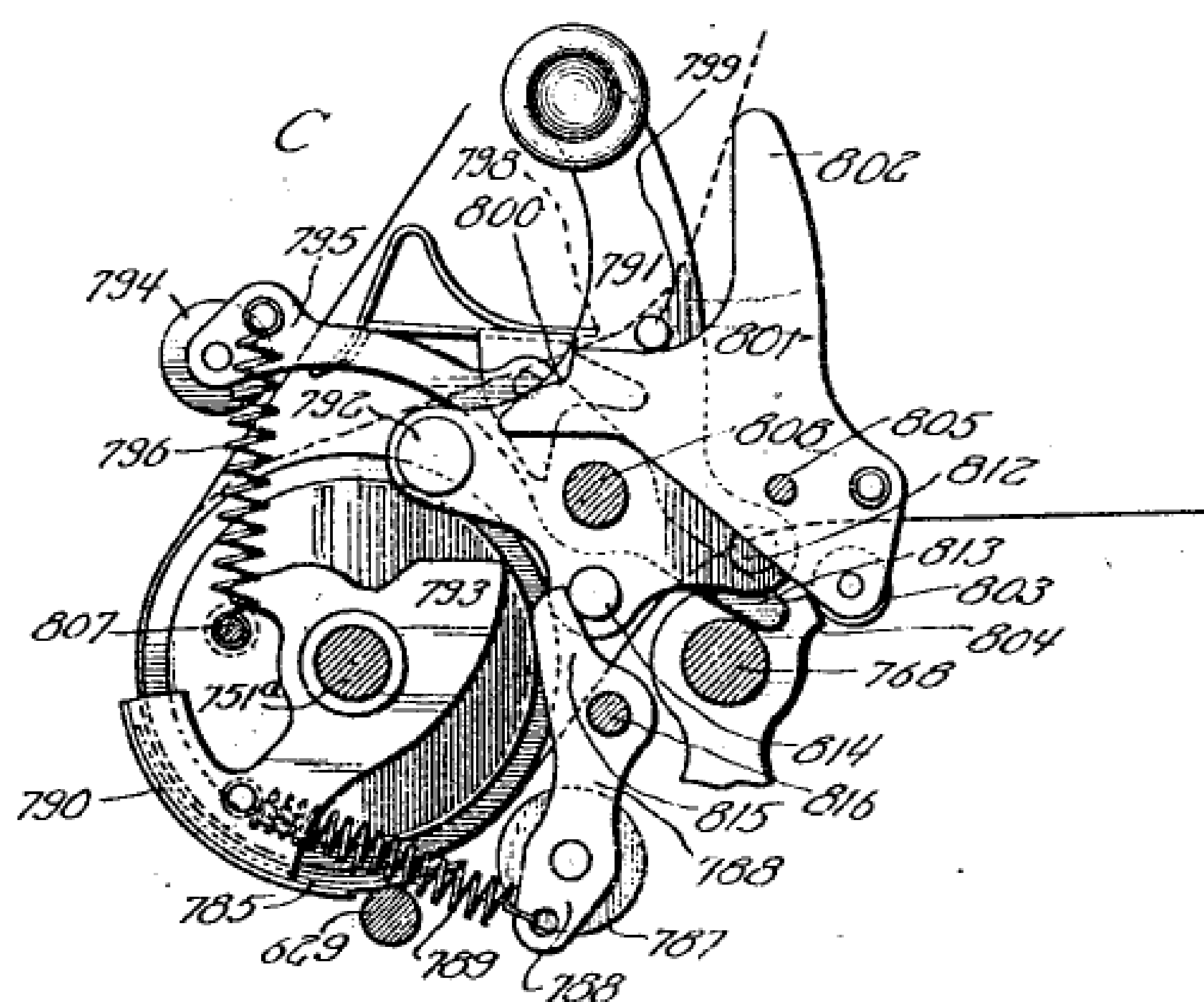
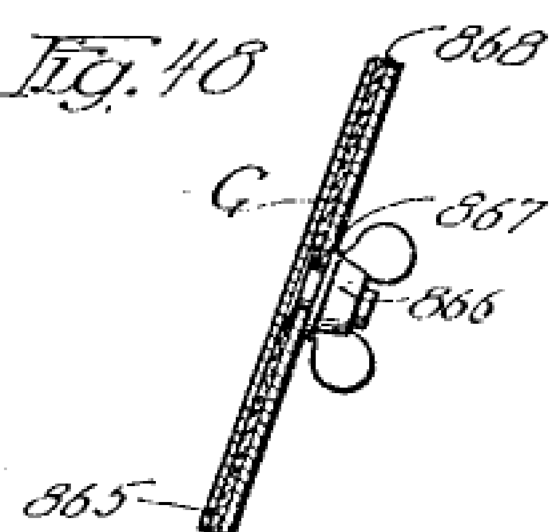


Fig. 48



Witnesses:
Frederick F. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane.
Atty.

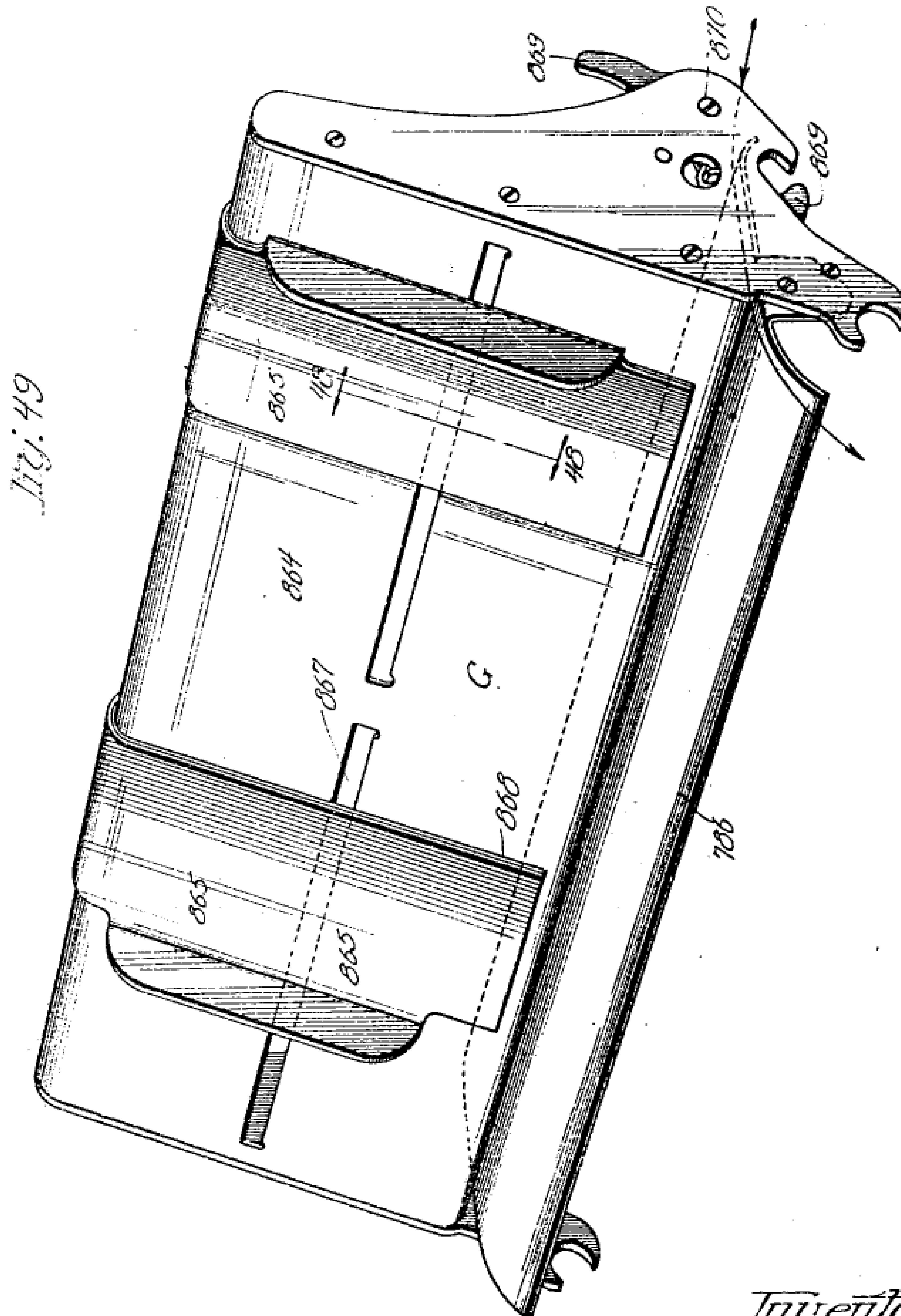
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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 40



Witnesses:
Frederick F. Mason
Arthur H. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

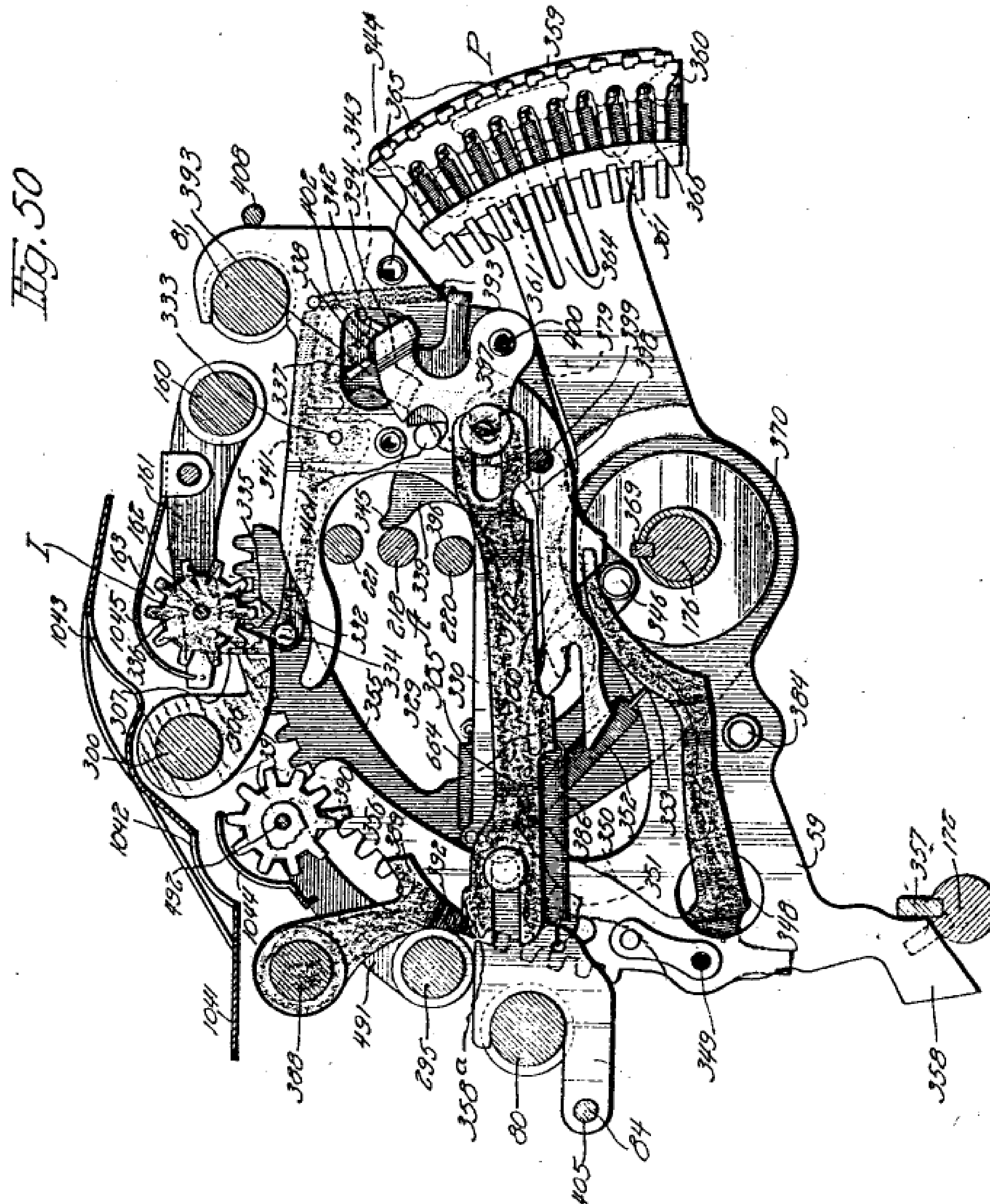
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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 41



Witnesses:
Frederick F. Mason
Arthur M. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p41.png

Oct. 27, 1925.

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M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

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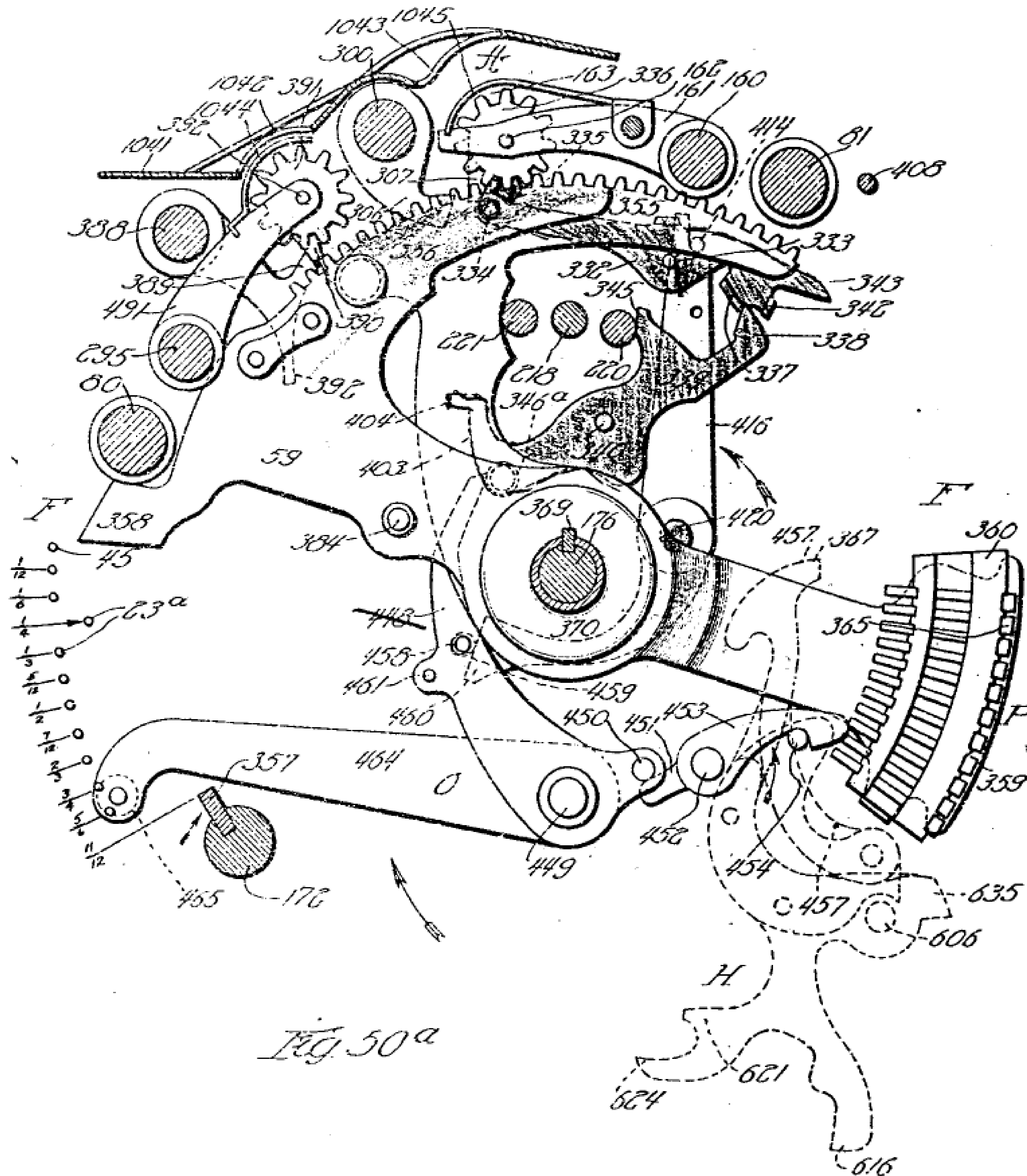


Fig. 50a

Witnesses:

Herbert G. Hahn

Merrill M. Blackburn

Inventor

Martin Teetor

by Wallace R. Lane.

Atty.

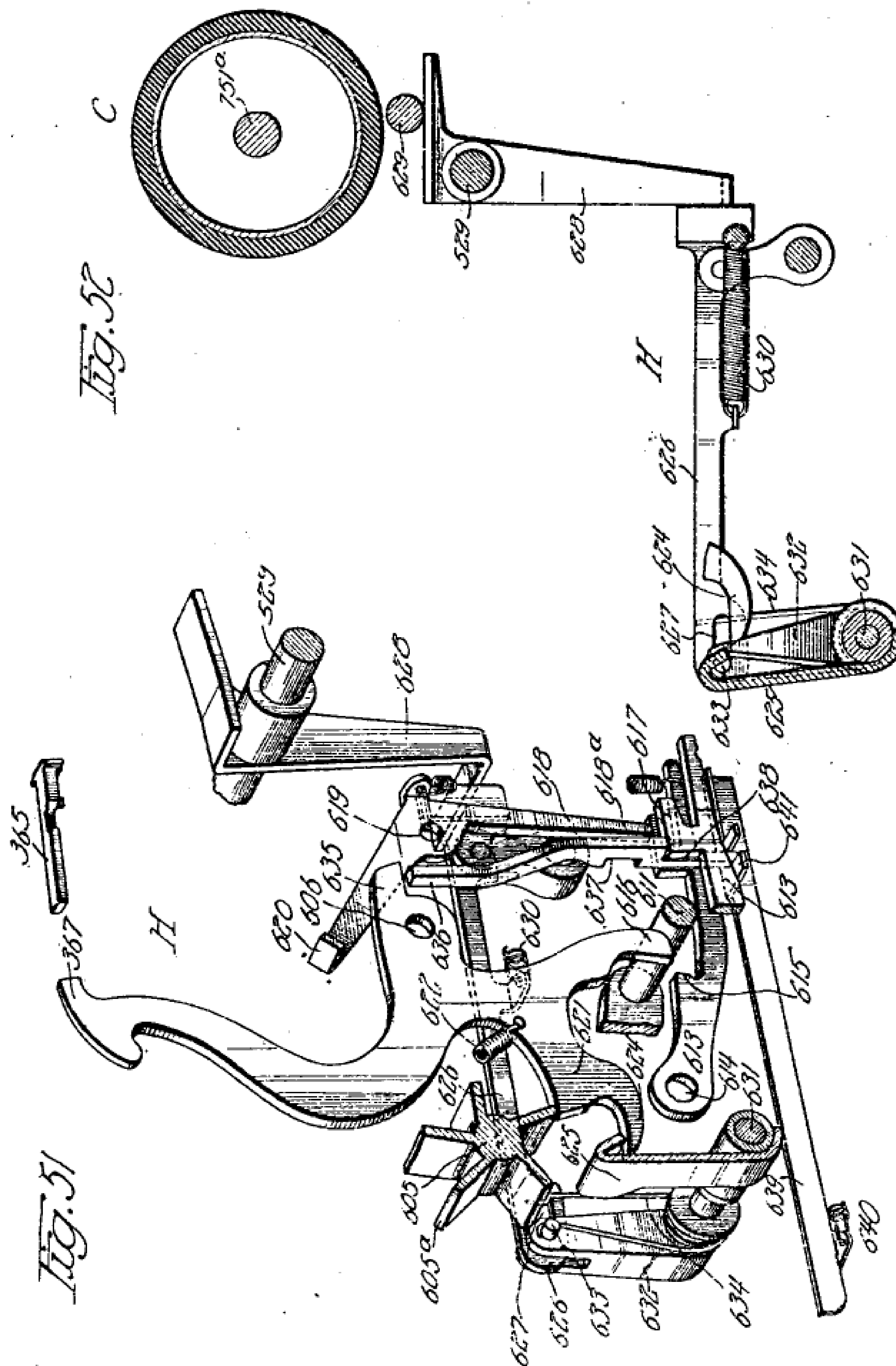
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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 43



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p43.png

Oct. 27, 1925.

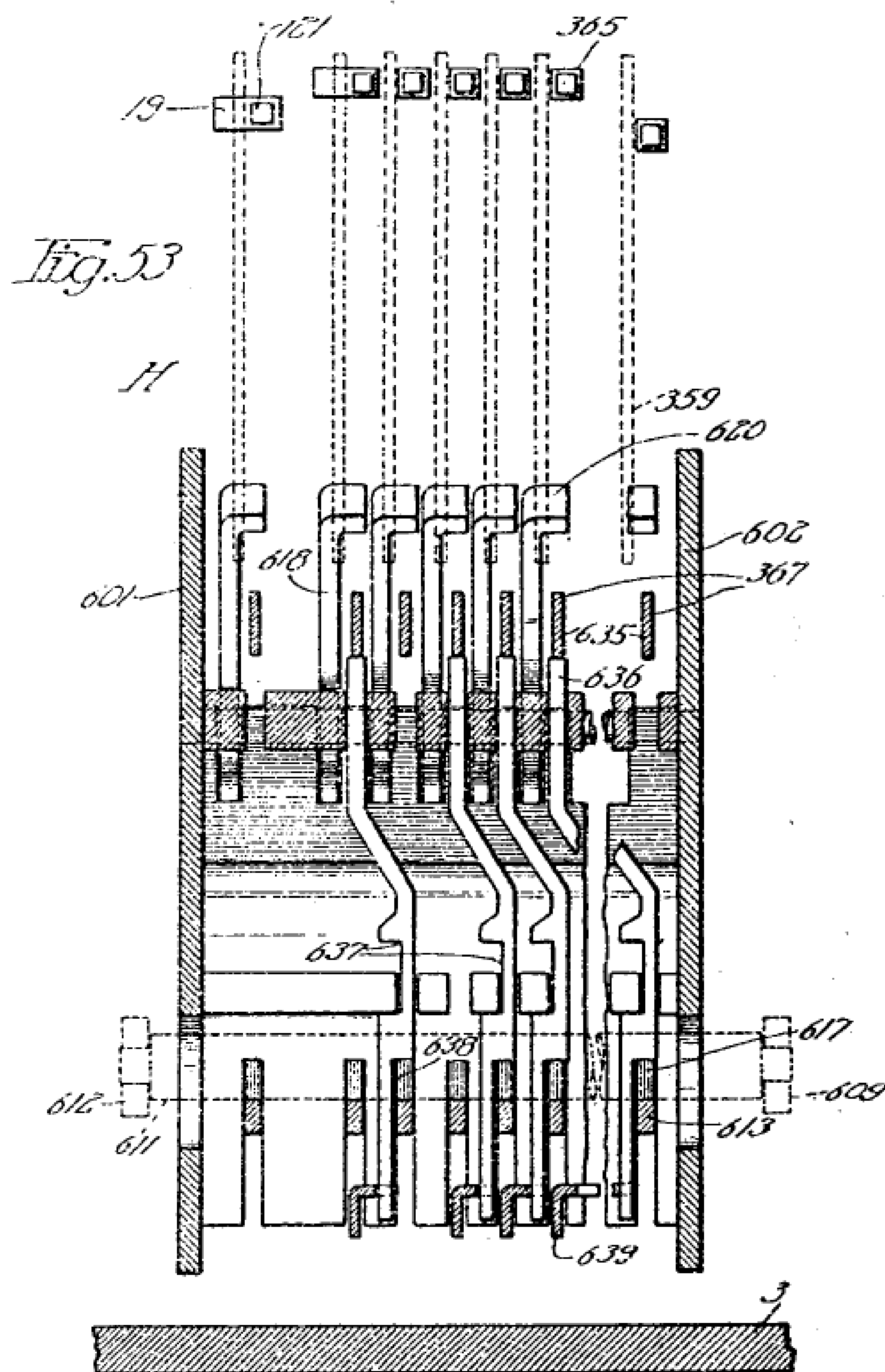
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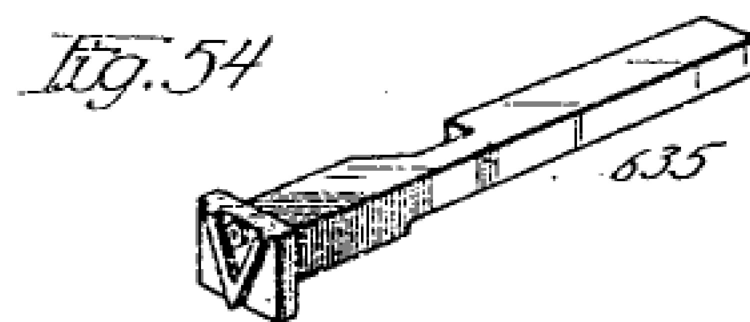
M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 44





Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

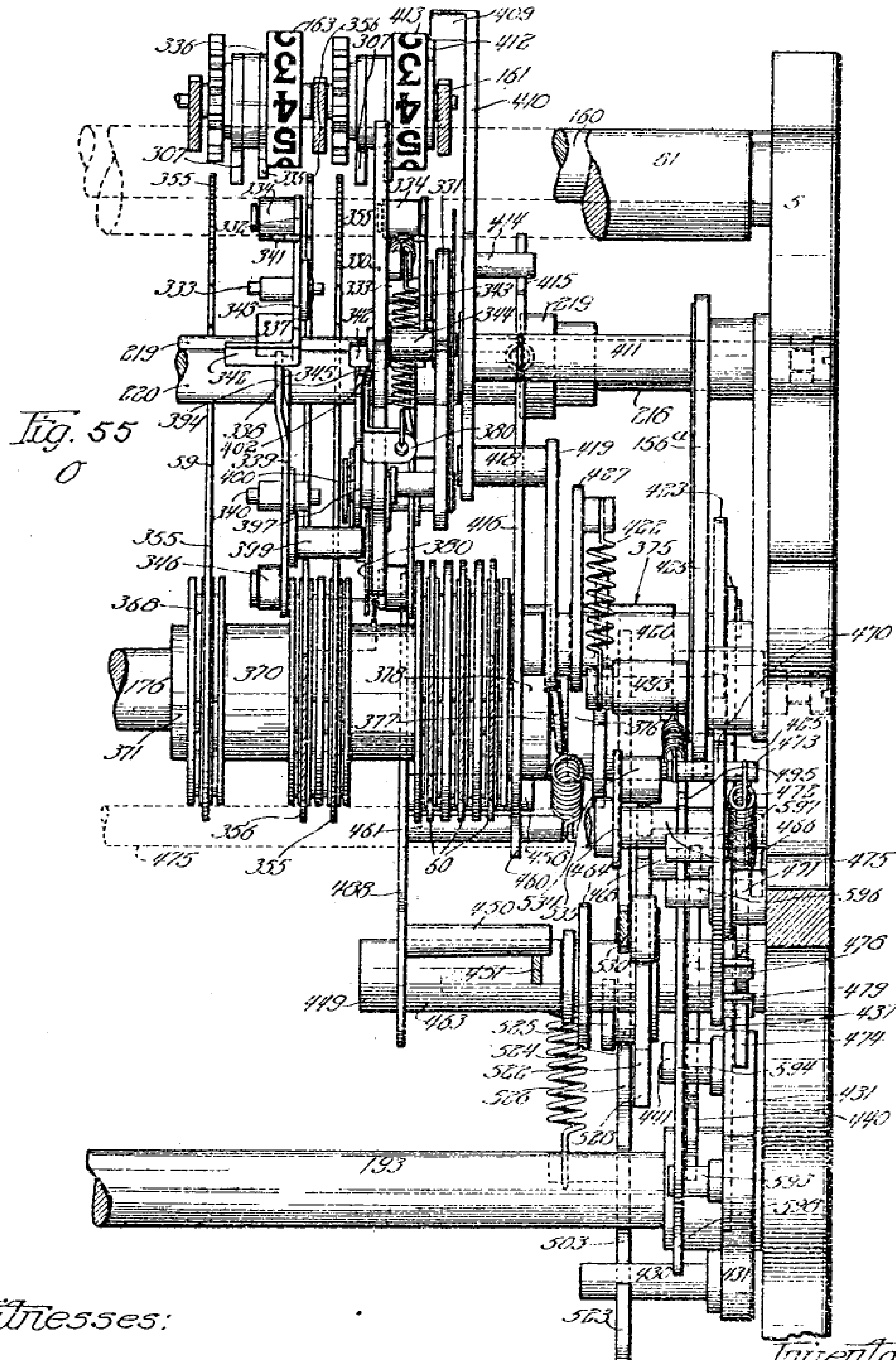
1925 10 27 US1558947 p44.png

Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 45



Witnesses:

Frederick F. Mason.

Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

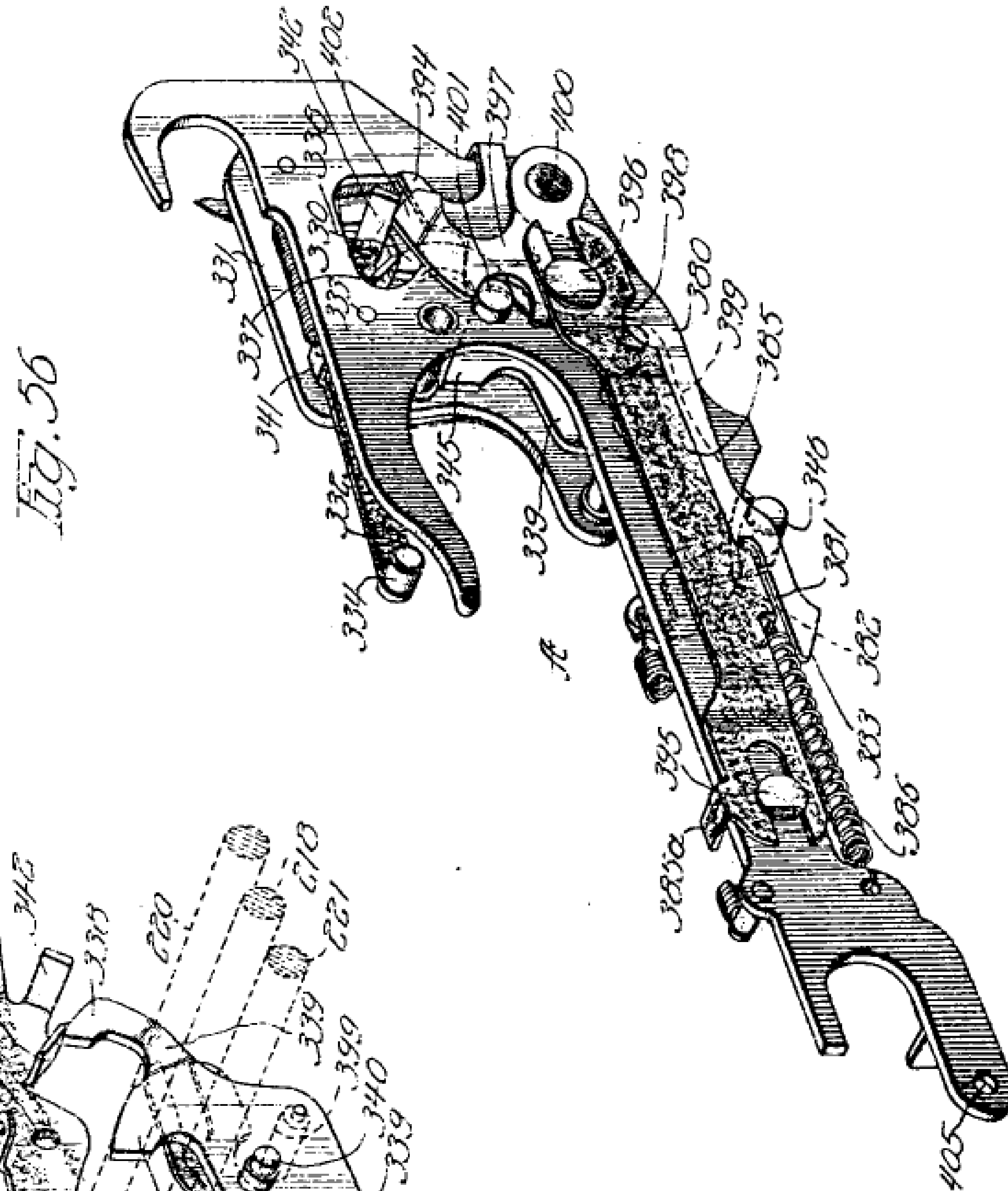
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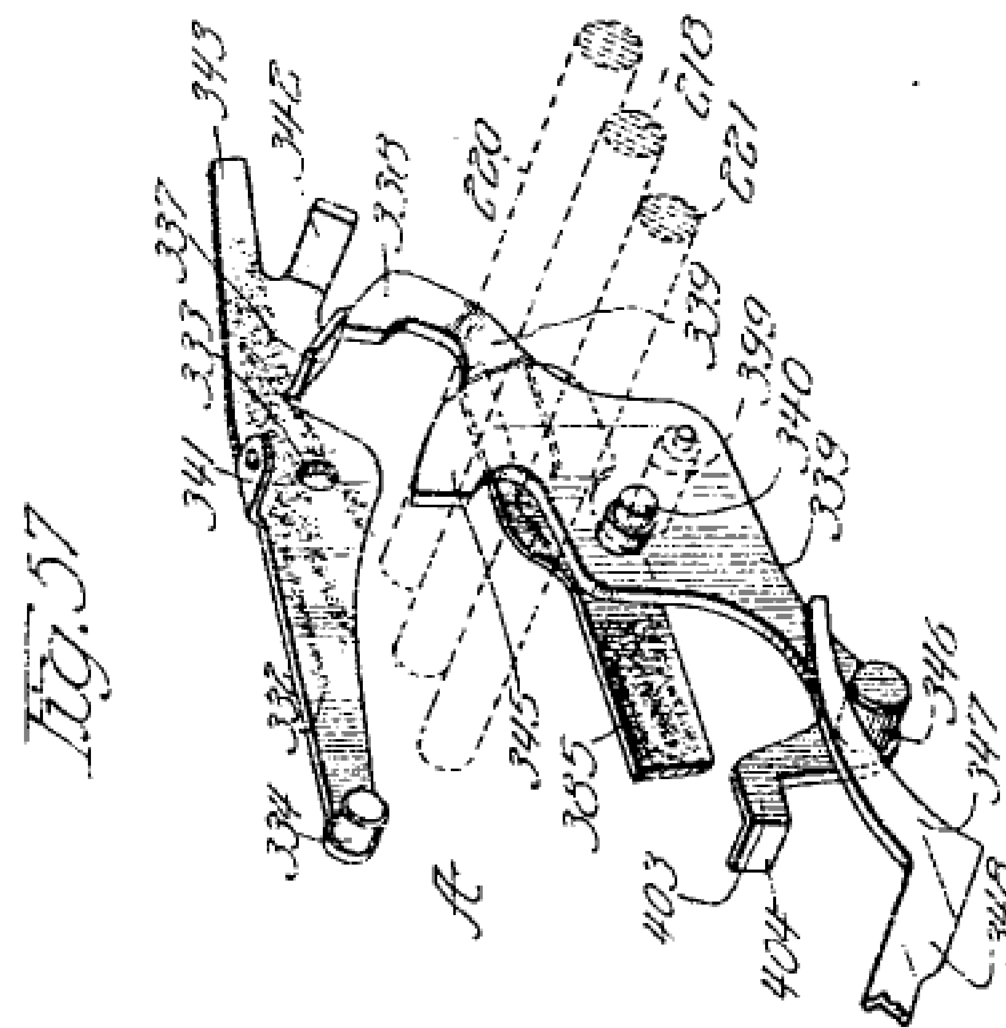
Oct. 27, 1925. **1,558,947**

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 46





Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p46.png

Oct. 27, 1925.

1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

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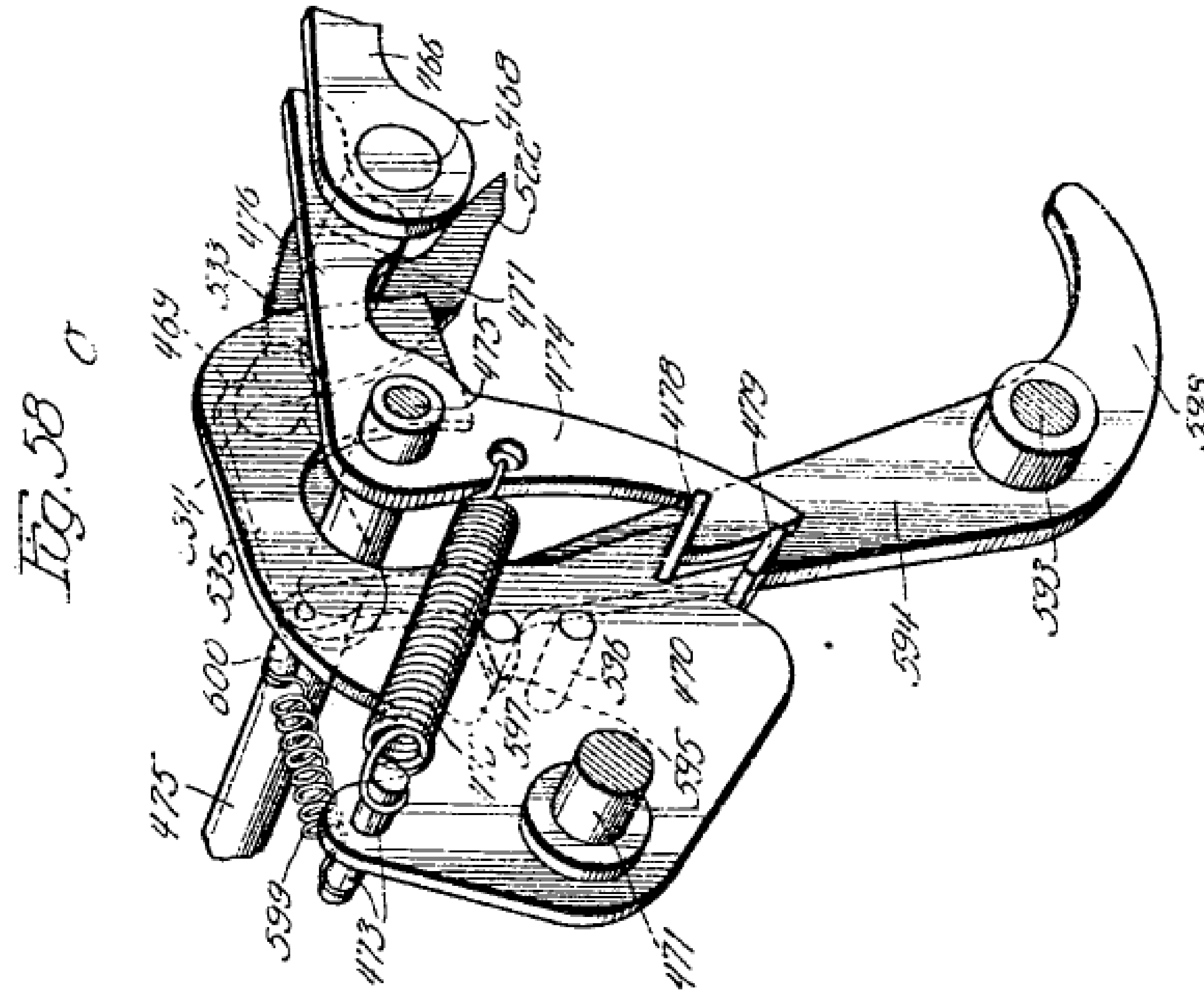


Fig. 58

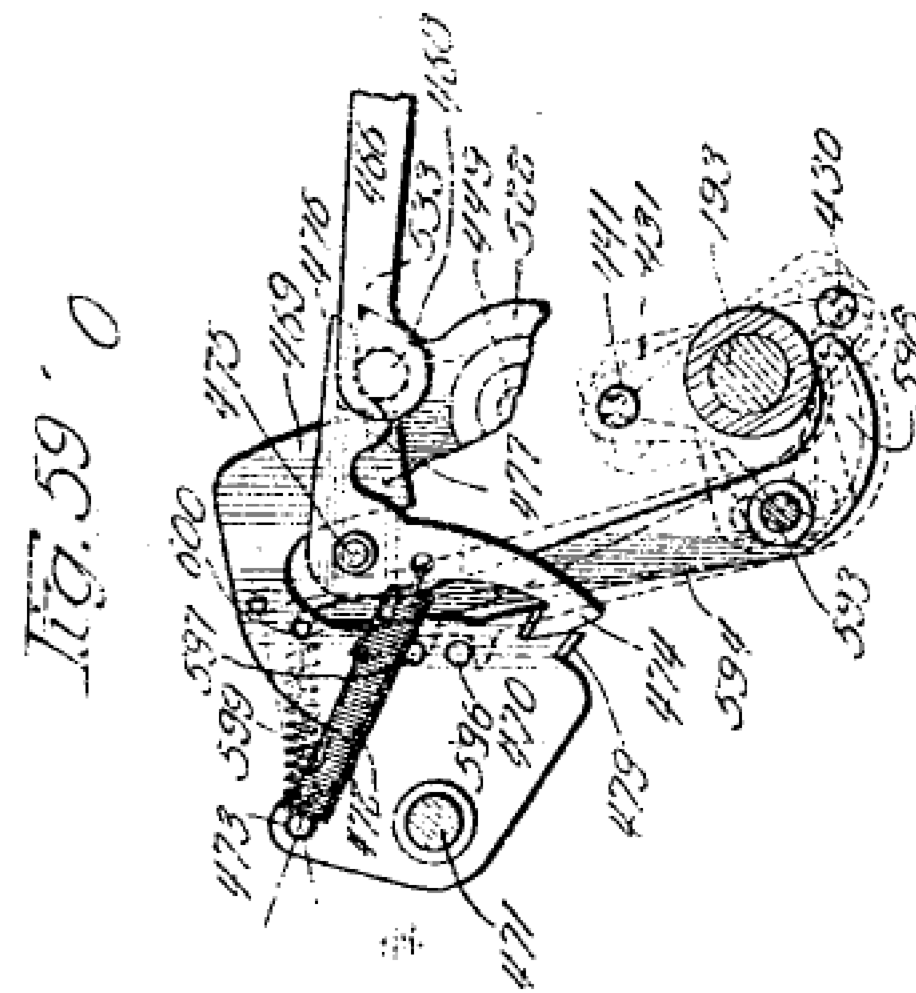


Fig. 59

Witnesses:
Frederick F. Mason
Arthur W. Carlson

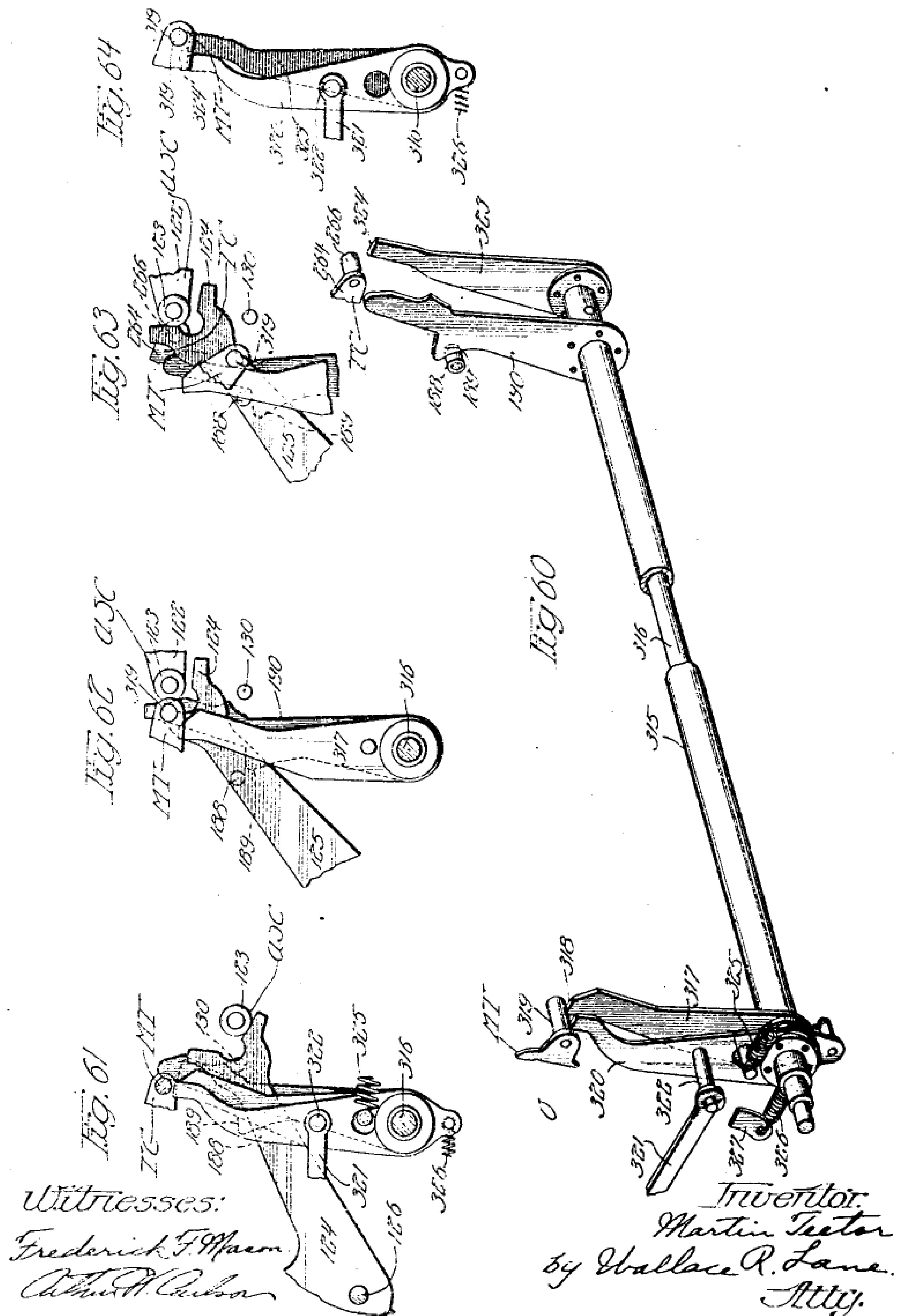
Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p47.png

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 48



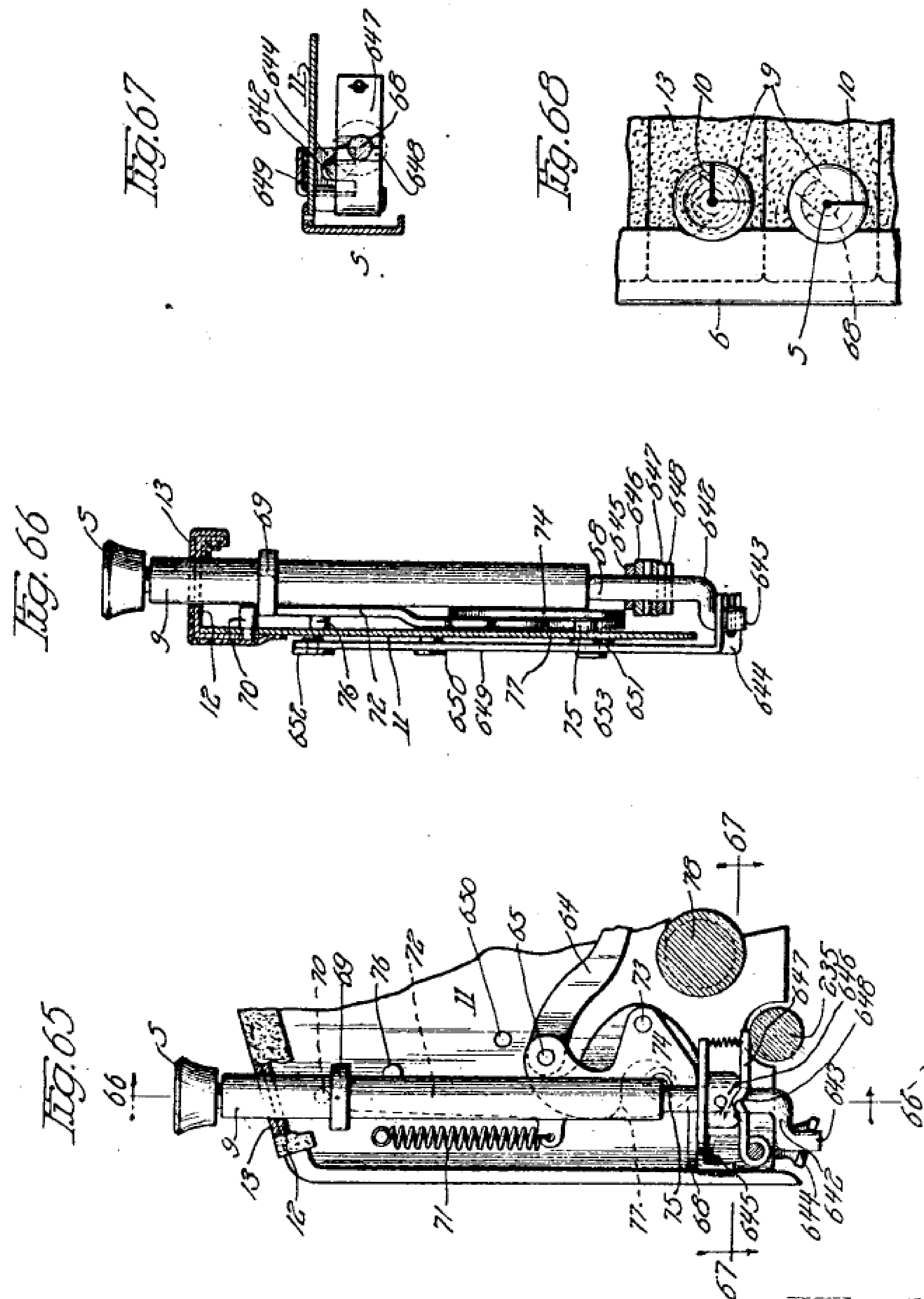
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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 49



Witnesses:
Frederick F. Mason
Arthur W. Carlson

Inventor
Martin Teetor
by Wallace R. Lane
Atty.

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Oct. 27, 1925.

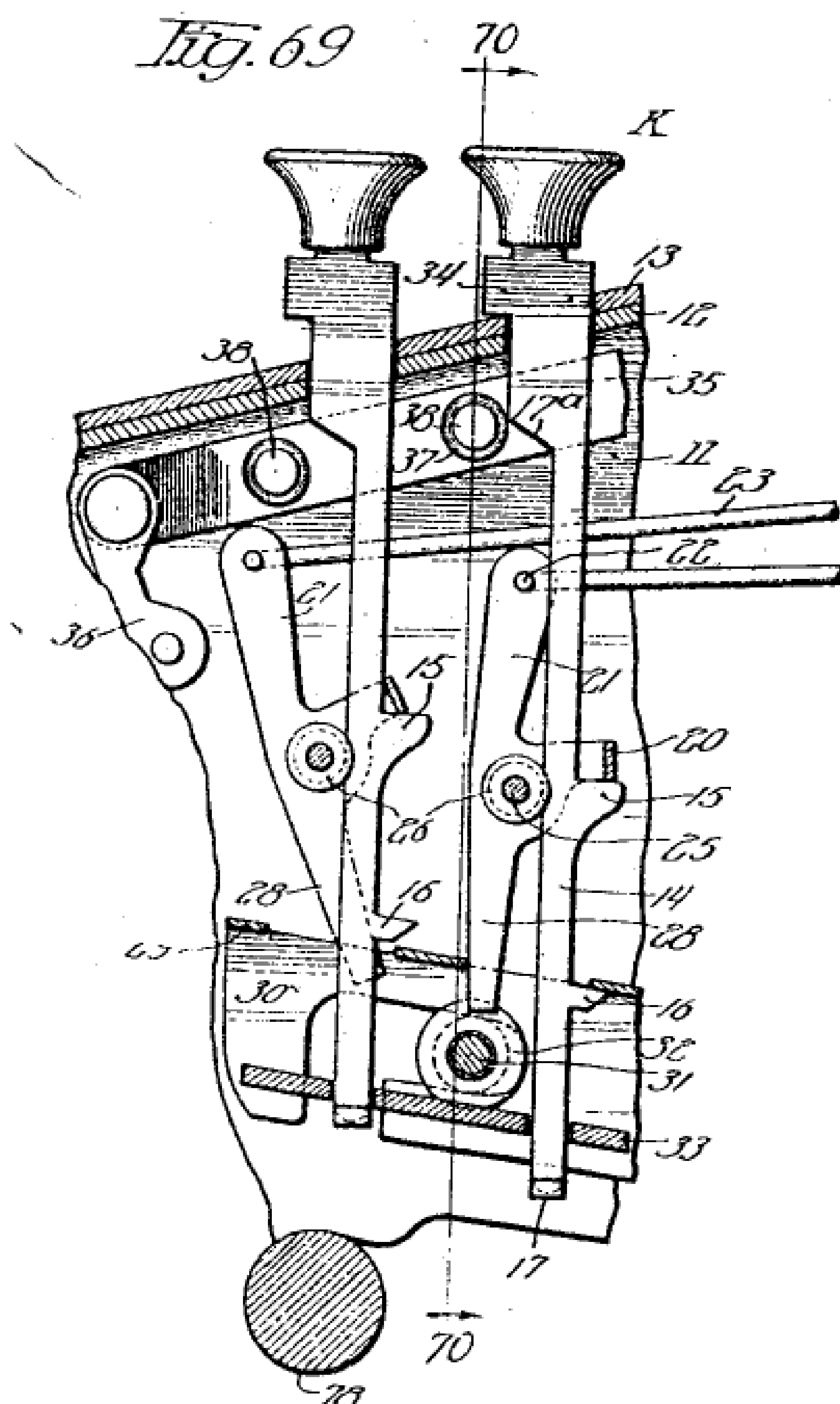
M. TEETOR

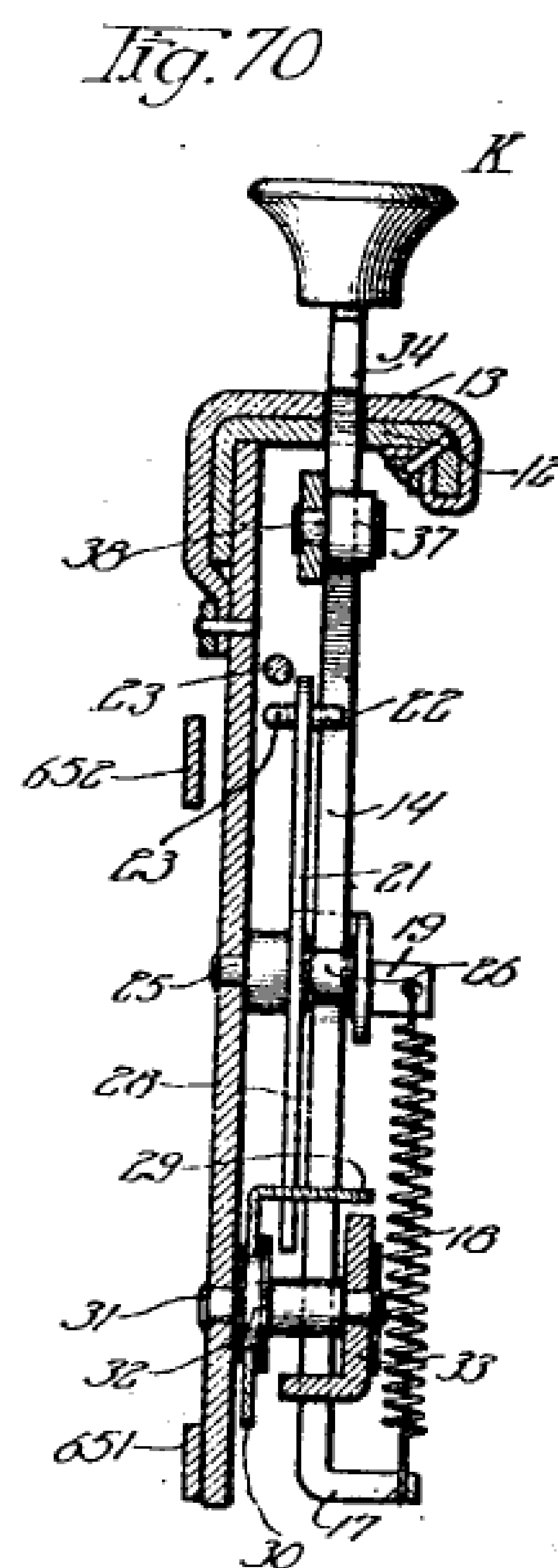
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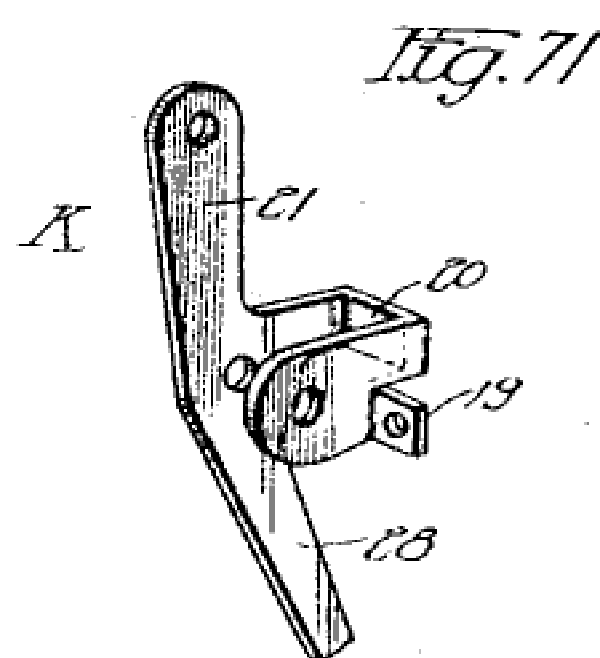
CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 50







Witnesses:
Frederick F. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

Oct. 27, 1925.

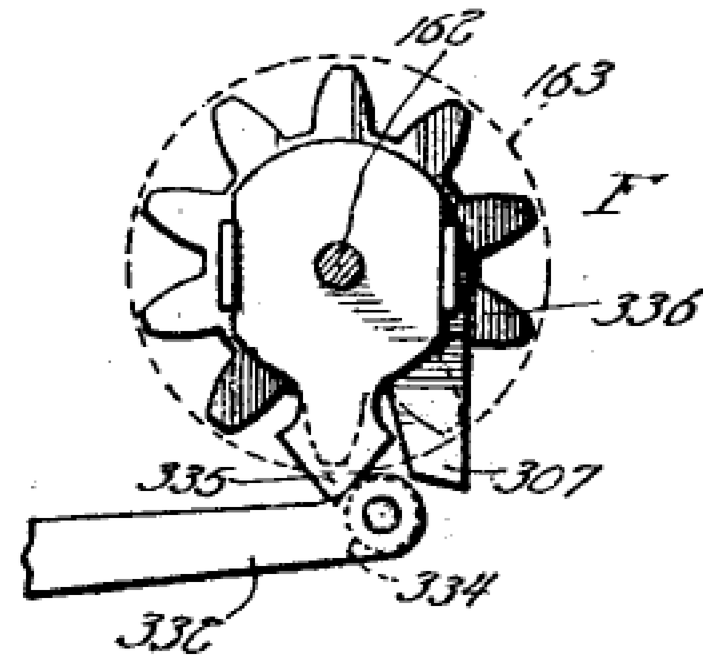
M. TEETOR

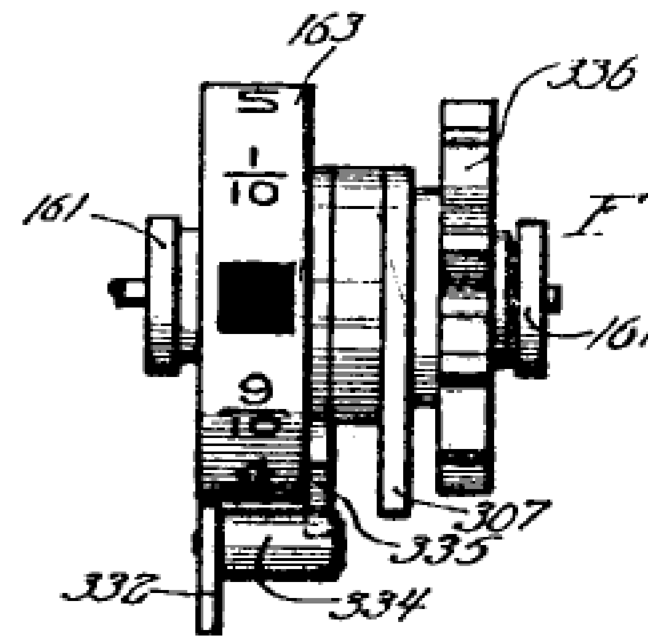
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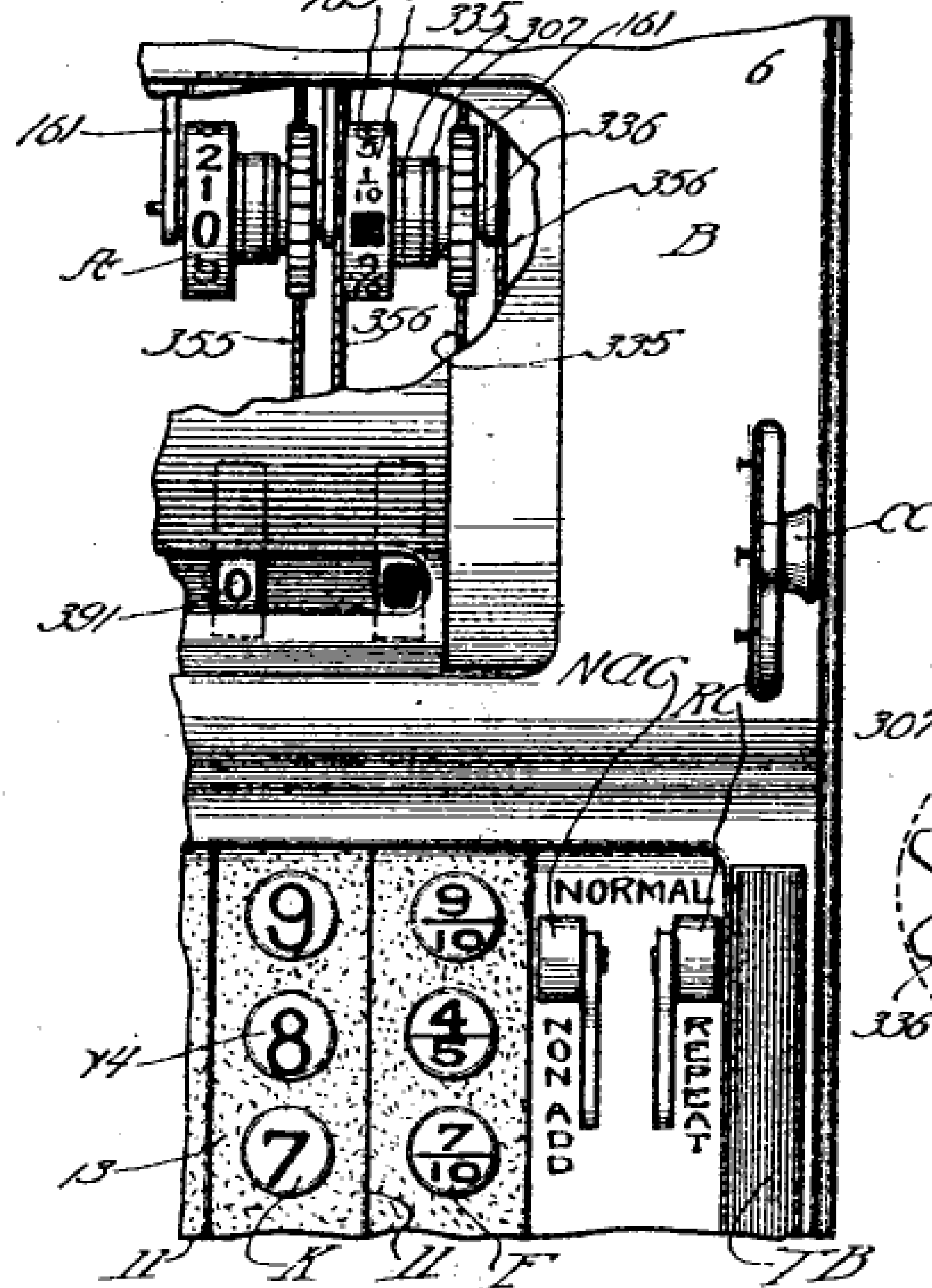
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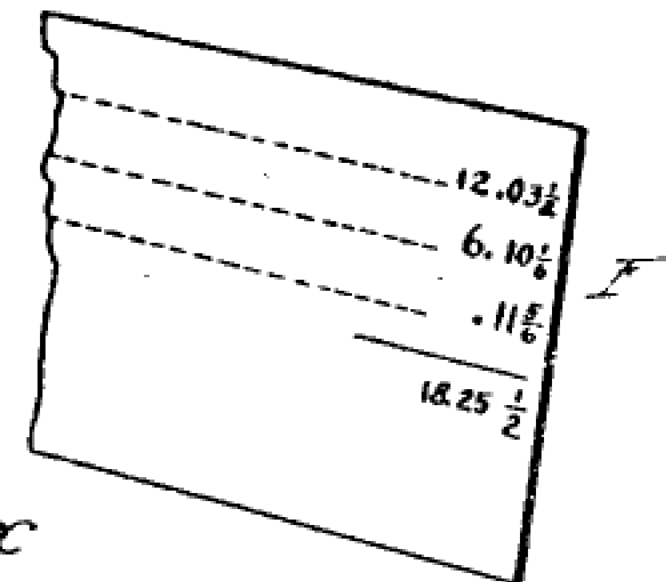
Filed May 1, 1920

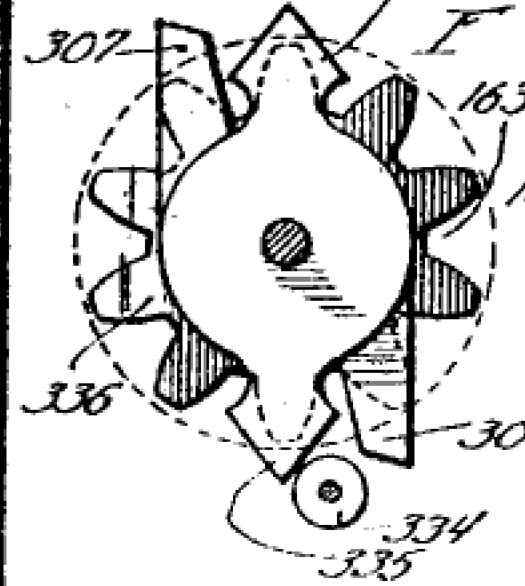
59 Sheets-Sheet 51

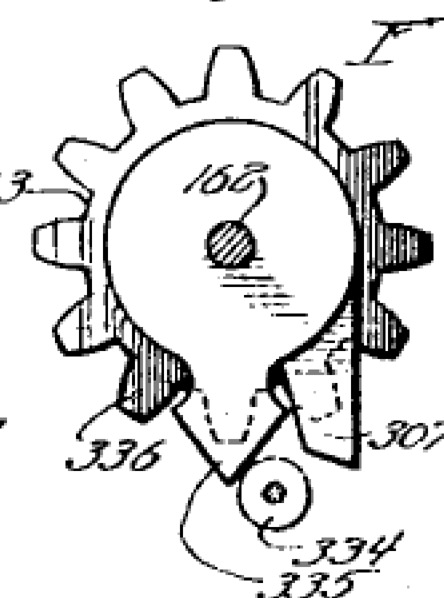












Witnesses
Hubert G. Halm
Merrill M. Blackburn

Inventor
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p51.png

Oct. 27, 1925.

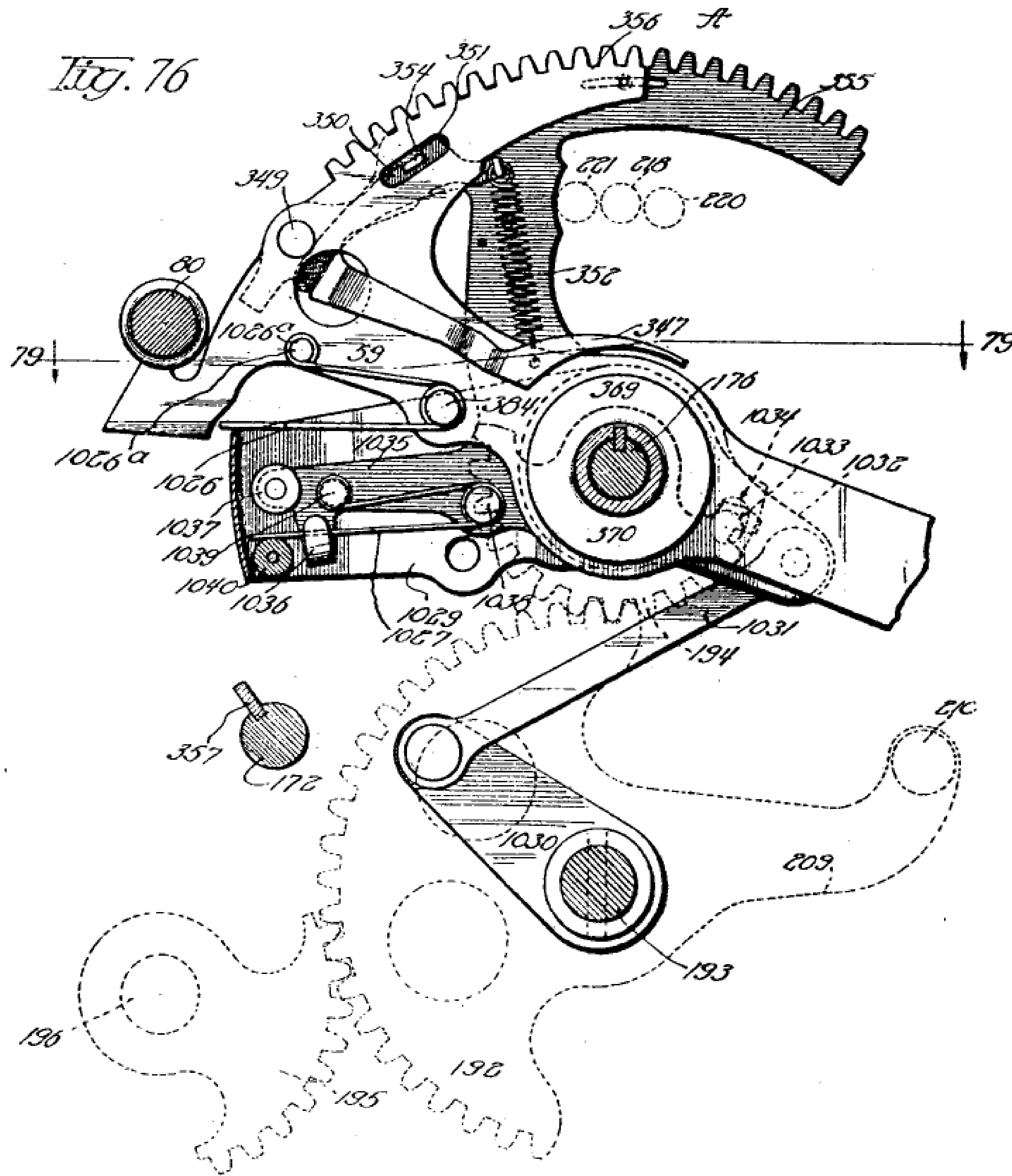
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 52



Witnesses:
Frederick F. Mason
Arthur H. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p52.png

Oct. 27, 1925.

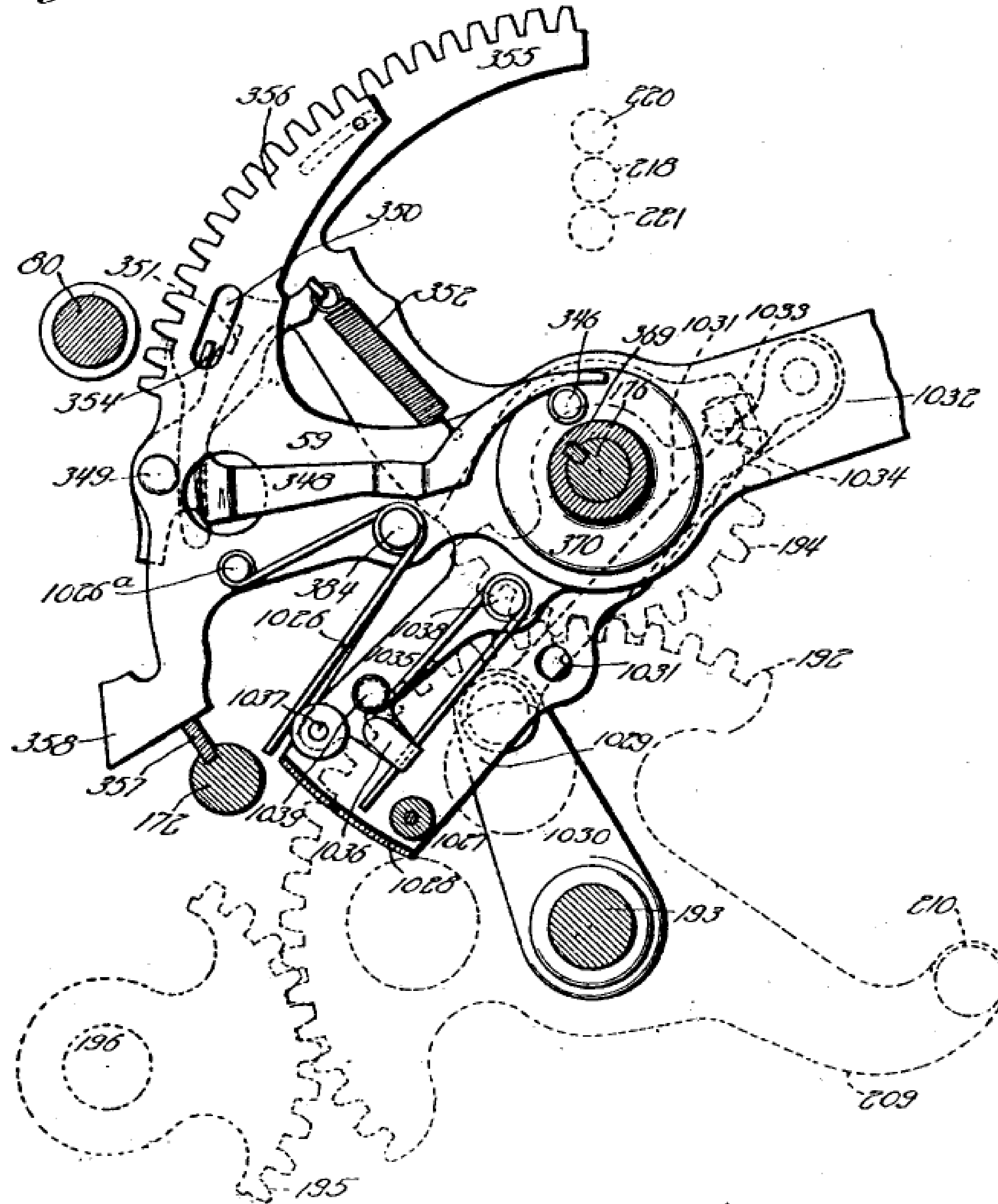
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 53



Witnesses:
Frederick F. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

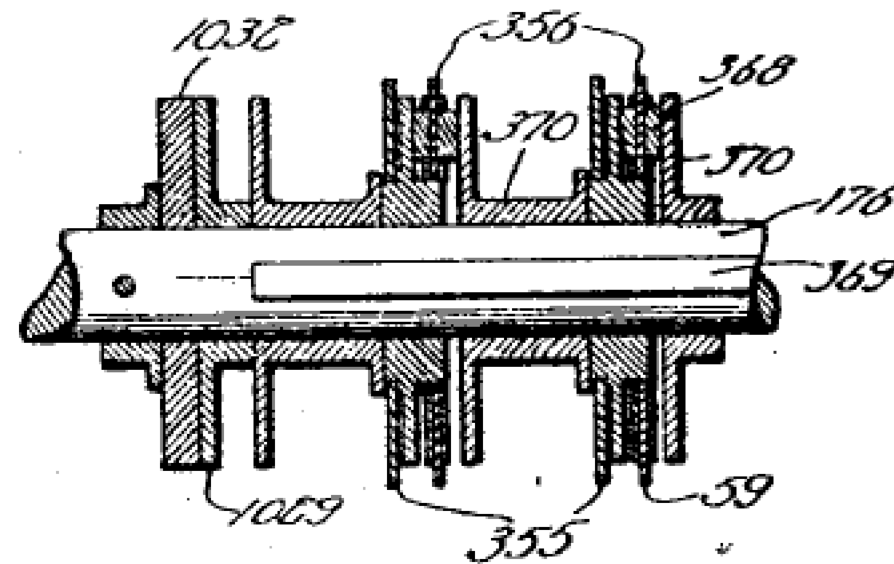
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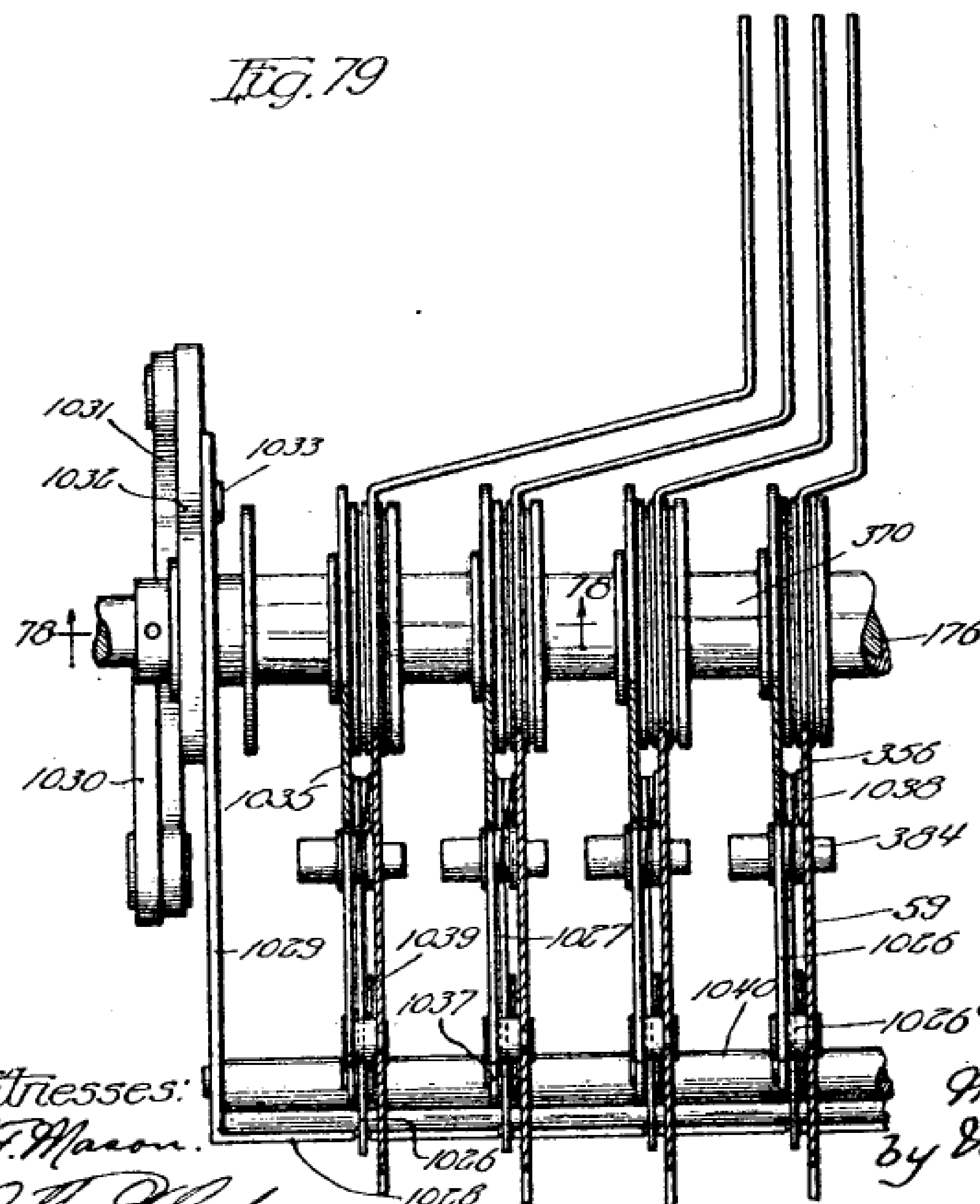
Oct. 27, 1925. **1,558,947**

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 54





Witnesses:
F. G. Mason.
Arthur W. Carlson

Inventor:
Martin Teetor
by Wallace R. Lane.
Atty.

1925 10 27 US1558947 p54.png

Oct. 27, 1925.

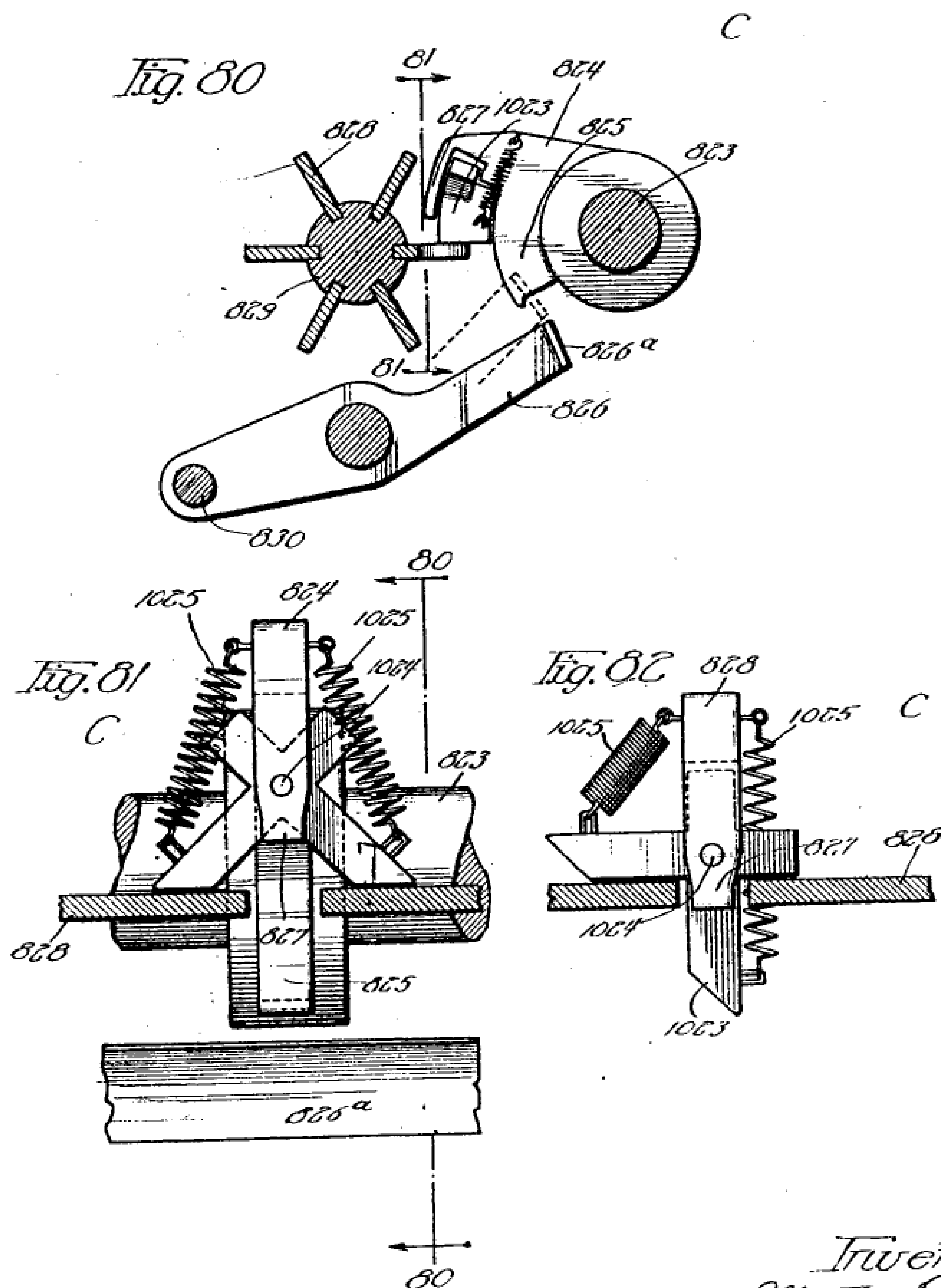
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 55



Witnesses:
Frederick F. Mason
Arthur M. [illegible]

Inventor:
Martin Teetor
by Wallace R. Lane
Atty.

1925 10 27 US1558947 p55.png

Oct. 27, 1925.

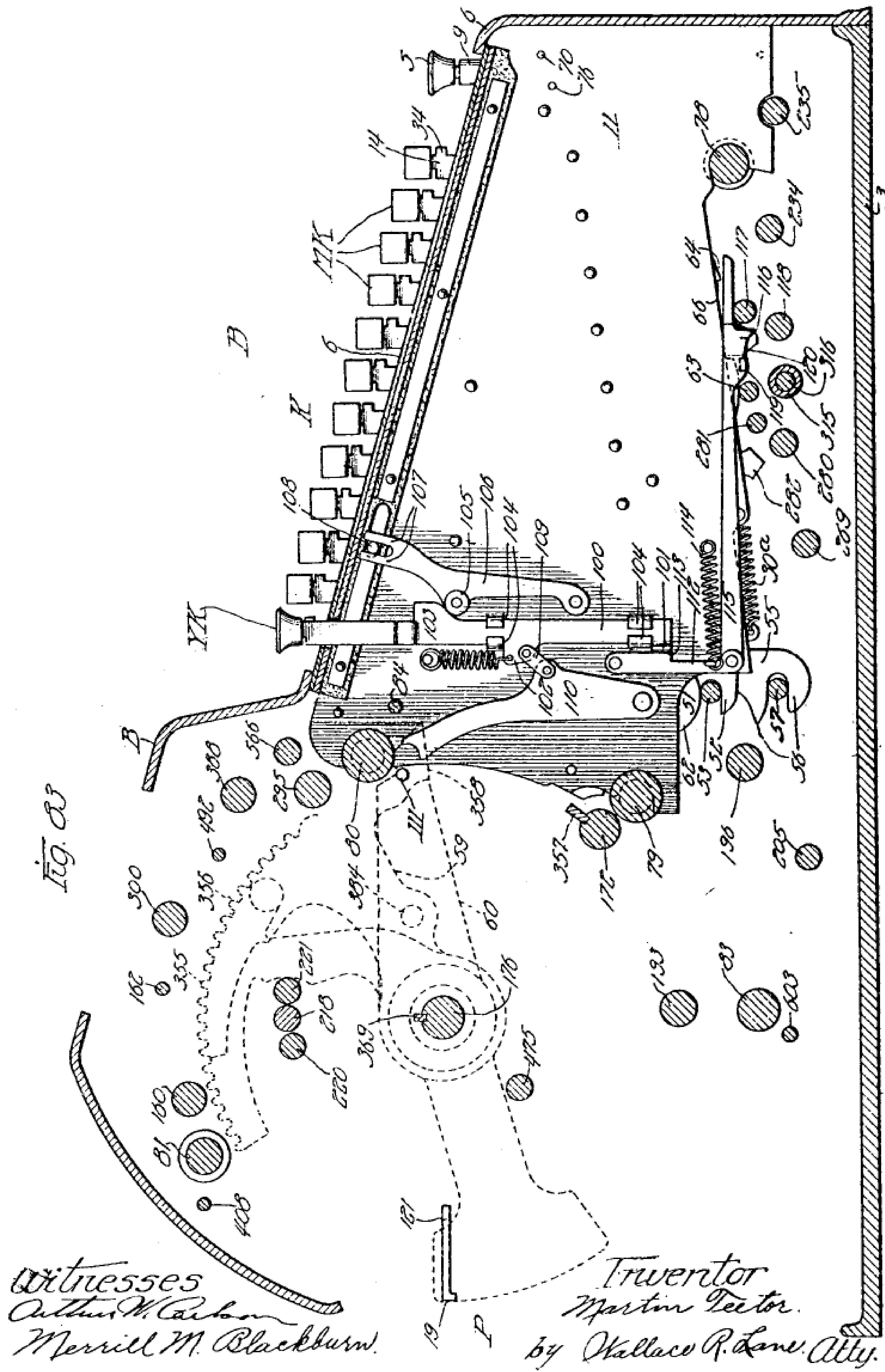
1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 56



Witnesses
Arthur W. Carlson
Merrill M. Blackburn

Inventor
Martin Teetor.
by Wallace R. Lane Atty.

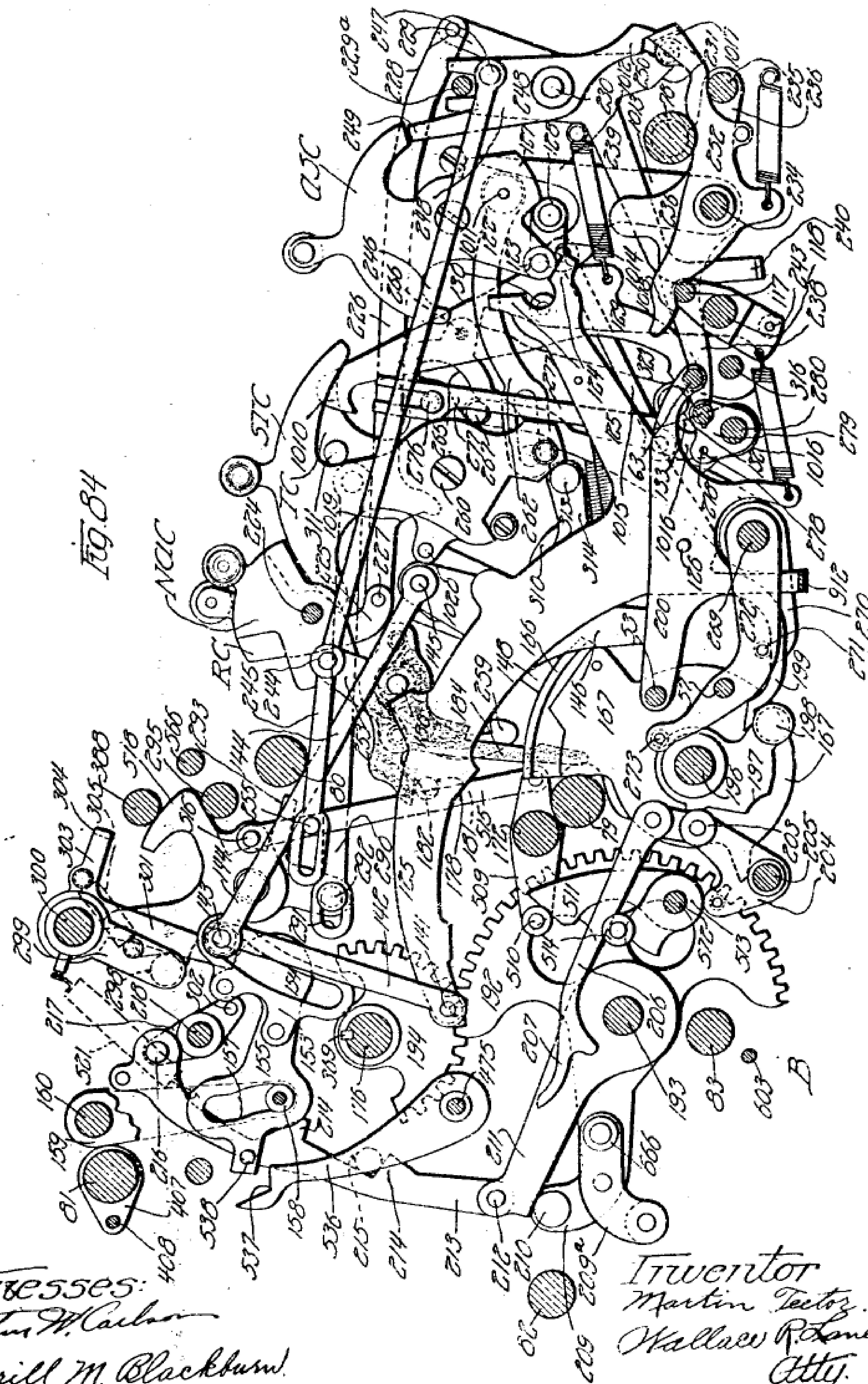
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Oct. 27, 1925. 1,558,947

M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 57



Oct. 27, 1925.

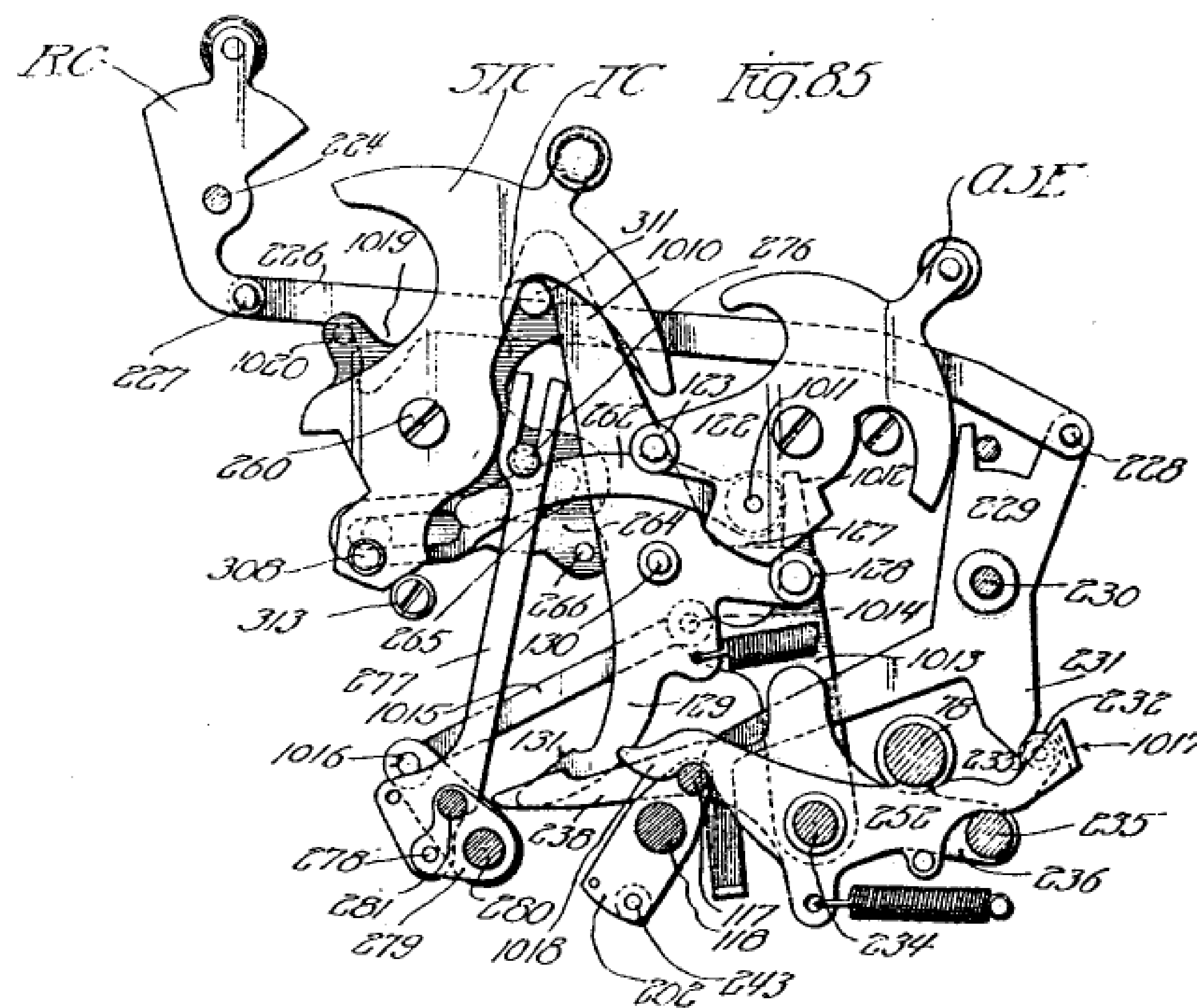
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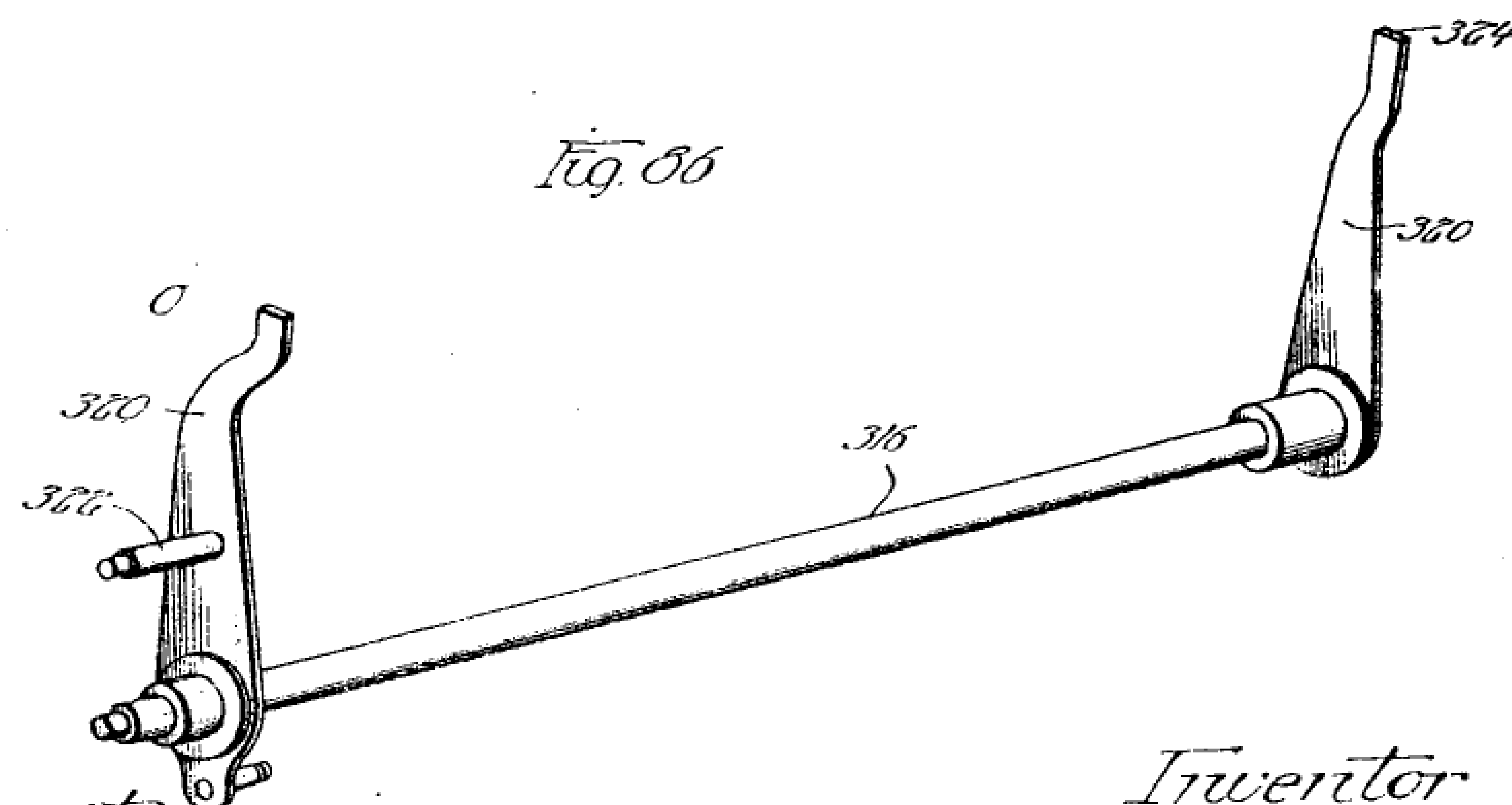
M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920

59 Sheets-Sheet 58





Witnesses:
Arthur W. Carlson
Merrill M. Blackburn

Inventor
Martin Teetor
by Wallace R. Lane Atty.

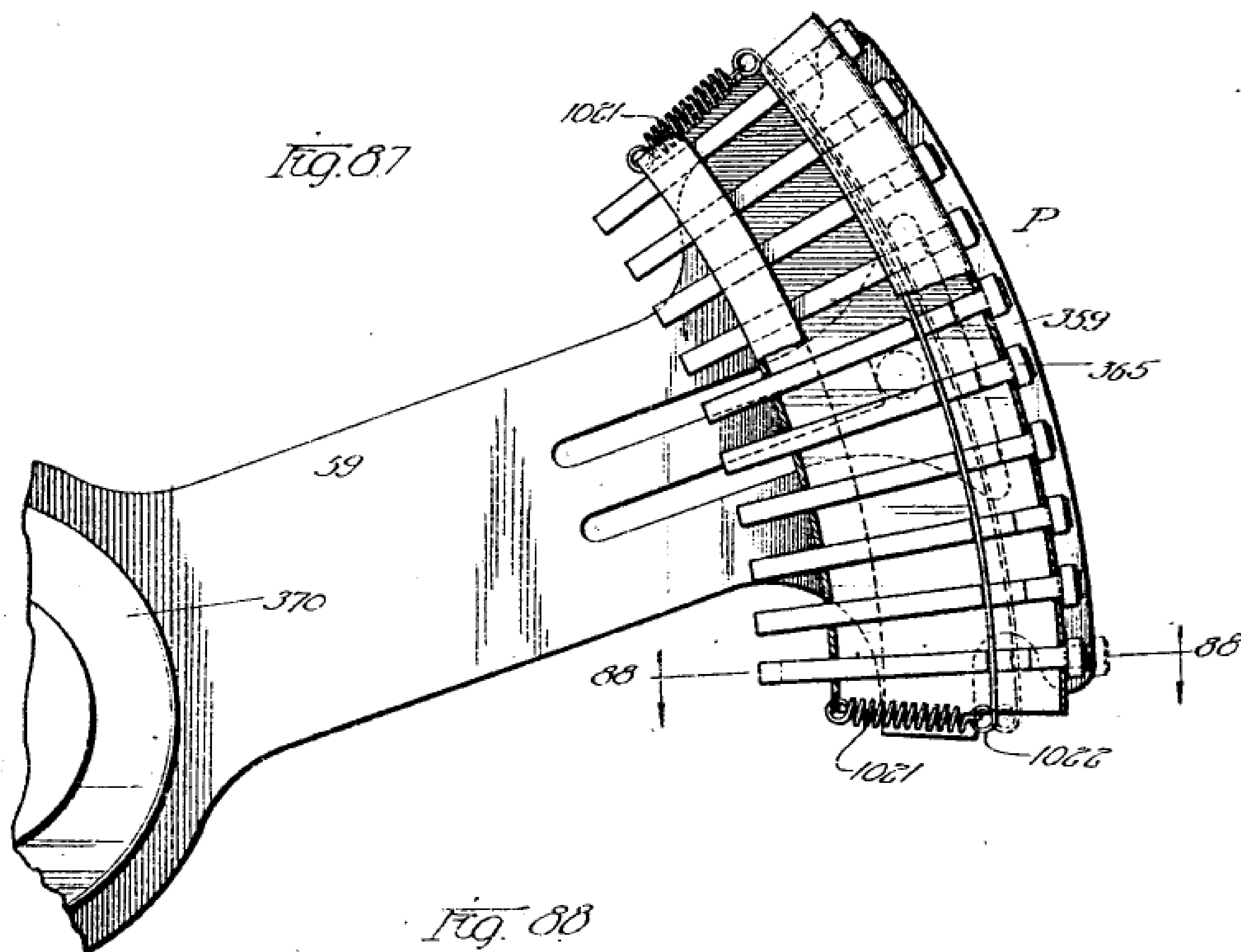
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Oct. 27, 1925. 1,558,947

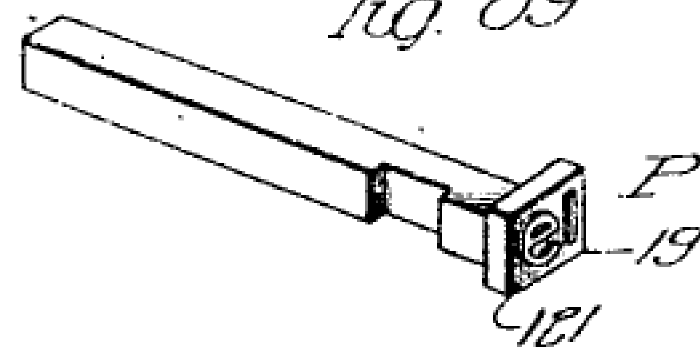
M. TEETOR

CALCULATING MACHINE

Filed May 1, 1920 59 Sheets-Sheet 59







Witnesses:
Arthur W. Carlson
Merril M. Blackburn.

Inventor
Martin Teetor
by Wallace R. Lane
Atty.

Patented Oct. 27, 1925. **1,558,947**

UNITED STATES PATENT OFFICE.

MARTIN TEETOR, OF DES MOINES, IOWA, ASSIGNOR TO TEETOR COMPANY, OF DES MOINES, IOWA, A CORPORATION OF IOWA.

CALCULATING MACHINE.

Application filed May 1, 1920. Serial No. 378,246.

To all whom it may concern:

Be it known that I, Martin Teetor, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented new and useful Improvements in Calculating Machines, of which the following is a specification.

Broadly stated, the objects of my invention are to improve upon some of the mechanisms heretofore used in computing machines, and to provide mechanisms for carrying out certain functions not heretofore carried out mechanically. More specifically stated, among the objects of my invention are the following:

1. To provide a mechanism for getting a net credit or overdraft, should the machine subtract beyond zero; (2) to provide for printing a net credit or overdraft in a distinctive manner; (3) to provide a distinctive character to indicate overdrafts or net credits; (4) to provide for raising and lowering the printing ribbon when printing an overdraft or net credit; (5) to provide a flexible keyboard structure; (6) to provide for shifting of the carriage by a motor and to provide for controlling this by the addition and subtraction lever; (7) to provide for simultaneous splitting of the numeral indicator, digit wheels, and hammer section; (8) to provide a dater mechanism which will print the year; (9) to provide for the addition, subtraction, etc. of fractions; (10) to provide a digit wheel not directly controlled by the key board but to which transfers may be made, thereby increasing the capacity of the machine without increasing the number of banks of keys; (11) to place all operation predetermining control levers on top of the keyboard; (12) to provide in a calculating machine a timing mechanism; (13) to improve upon the driving mechanism; (14) to provide an interlock between the controls on the right and left sides of the machine; (15) to provide for returning of the repeat control by the operation of the total or subtotal control; (16) to provide an automatic means for returning the non-add control; (17) to provide a spring mechanism for transferring with more speed; (18) to improve upon the transfer mechanism; (19) to provide an automatic shifting mechanism for the carriage; (20) to provide for controlling the carriage shifting mechanism from the keyboard; (21) to provide a new type of platen clutch and release; (22) to improve upon existing carriages and to provide automatic control therefor; (23) to provide in a machine of this character an improved paper support; (24) to provide an improved paper guideway; (25) to improve upon the hammer section mechanism; (26) to improve upon the type holder; (27) to improve upon the friction mechanism used in the drive for the sectors; (28) to provide locking means to prevent dismantling of the machine; (29) to provide locking means to prevent unauthorized operation of the machine; and (30) such further objects, advantages, and capabilities as will later more fully appear.

My invention further resides in the combination, construction, and arrangement of parts illustrated in the accompanying drawings, and while I have shown therein preferred embodiments, I desire the same be understood as illustrative only and not as limiting my invention. The structure described and claimed in this application is an illustrative embodiment of the invention, the same being shown in the accompanying drawings, in which Fig. 1 is a side elevation of a ledger posting machine embodying my improvements mounted upon a supporting stand as usual.

Figs. 2 and 2ª constitute a plan view of my improved mechanism. Fig. 3 is a right side elevation with the casing in section taken along the line 3—3, Fig. 9, and showing part of the improved structure within the casing.

Fig. 4 is a fragmentary sectional elevation of the right side of the machine with part of the casing broken away.

Fig. 5 is a vertical section through the machine, taken in a plane indicated by the line 5—5, Fig. 14.

Fig. 6 is a view similar to Fig. 5 in substantially the same plane, but showing the position of the parts when the non-add key has been actuated.

Fig. 7 is a fragmentary vertical section through one side of the casing and frame, and some of the connected mechanism to

show the available space between casing and frame to be utilized for control parts.

Fig. 8 is a fragmentary vertical section along the plane indicated by the line 8—8, Fig. 5.

Fig. 9 is a rear elevation of the machine with the carriage and paper carrier removed, and the casing in section.

Fig. 10 is a vertical section on the plane indicated by the line 10—10, Figs. 2 and 2ª, showing the hammer mechanism in section.

Fig. 11 is a vertical section on the plane indicated by the line 11—11, Fig. 10, showing Babbitt kidneys on friction driven sectors.

Fig. 12 is a vertical section on the plane indicated by the line 12—12, Figs. 2 and 2ª, showing month keyboard section.

Fig. 13 is a vertical section along the plane indicated by the line 13—13, Figs. 2 and 2ª, showing accumulating segment device and mechanism for splitting hammer section and accumulator wheel mechanism.

Fig. 14 is a sectional plan along the plane indicated by the line 14—14, Figs. 5 and 15.

Fig. 15 is a vertical section along the plane indicated by the line 15—15, Fig. 14, showing complement mechanism, minus total and sub-minus total controls.

Figs. 16, 17, 18, 19 and 20 are sections along the planes indicated by the lines 16—16, 17—17, 18—18, 19—19, and 20—20, respectively, Fig. 15.

Fig. 21 is a vertical section along the plane indicated by line 21—21, Figs. 2, 2ª and 14.

Fig. 22 is a detail showing the position of the minus-total mechanism in one position thereof during the operation of finding the amount of an overdraft.

Fig. 23 is a plan view of the rear portion of the machine showing part of the keyboard and the dial and net credit or overdraft digit wheels.

Fig. 24 is a fragmentary sectional plan view showing parts of the rear of the machine with parts removed and various details of construction.

Fig. 25 is a section along the plane indicated by the line 25—25, Fig. 1, showing debit-credit control.

Fig. 26 is a broken section substantially along the plane indicated by the line 26—26, Fig. 29, showing time switch mechanism in normal position.

Fig. 27 is a vertical section along the plane indicated by the line 27—27, Fig. 26.

Fig. 28 is a vertical section along the plane indicated by the line 28—28, Fig. 27.

Fig. 29 is a plan section substantially along the plane indicated by the lines 29—29, Figs. 4 and 26, showing time switch and driving mechanism in normal position.

Fig. 30 is a side view of the time switch and drive with castings removed. (Machine in operation.)

Fig. 31 is a vertical section along the plane indicated by the line 31—31, Fig. 4, showing motor driven carriage mechanism.

Fig. 32 is a fragmentary elevation of the left side of the motor and some of the mechanism connected therewith.

Fig. 33 is the same as Fig. 32, omitting carriage clutch and carriage, and showing addition-subtraction control in subtracting position.

Fig. 34 is a sectional plan substantially along the plane indicated by the line 34—34, Fig. 33.

Fig. 35 is a vertical longitudinal detail section of the sub-minus total mechanism for causing machine to make a half revolution and stop.

Fig. 36 is a perspective view of a part of the mechanism shown in Fig. 35, and showing the connection therewith of the sub-minus total mechanism.

Fig. 37 is a vertical longitudinal detail section substantially along the plane indicated by the line 37—37, Fig. 2.

Fig. 38 is a left end elevation of the carriage showing the hammer section and means for locking it by raising the carriage platen.

Fig. 39 is a transverse section on the line 39—39 of Fig. 37, showing the ribbon and carriage mechanism.

Fig. 40 is a sectional plan showing the relative position of the type, ribbon, parts of the mechanism for actuating the latter, and part of the hammer splitting mechanism.

Fig. 41 is a right end elevation of the carriage, showing controls for same.

Fig. 42 is a fragmentary elevation along the plane indicated by the line 42—42, Fig. 41, showing clutch mechanism for operating platen.

Fig. 43 is a detail of the line spacing mechanism.

Fig. 44 is a transverse section of the carriage and some controls connected therewith, with platen raised position, and showing how to determine printing position.

Fig. 45 is a fragmentary view looking in the direction of the arrow, Fig. 44.

Fig. 46 is a view similar to Fig. 44, but showing controls in position for inserting paper.

Fig. 47 is similar to Figs. 44 and 46 with the parts in different positions, the friction rollers being removed from the paper.

Fig. 48 is a section along the plane indicated by the line 48—48, Fig. 49, showing paper guide locking means.

Fig. 49 is a perspective view of the paper support and its connected guides.

Fig. 50 is a vertical longitudinal section in detail of the transfer and overdraft mechanism.

Fig. 50ª is similar to Fig. 50, showing

the mechanism in a different part of the operative cycle, and also showing the fractional sector.

Fig. 51 is a detail sectional perspective view of a portion of the hammer section, showing means for locking hammer by lifting the platen.

Fig. 52 is a transverse sectional elevation of a portion of the mechanism shown in Fig. 51.

Fig. 53 is a sectional elevation substantially along the plane indicated by the line 53—53, Fig. 10, showing splitting and hammer releasing mechanism.

Fig. 54 is a perspective view of the type used to indicate a number which has caused an overdraft.

Fig. 55 is a fragmentary rear sectional elevation of the machine with the casing removed, showing the overdraft mechanism connection with the numeral digit wheels and the construction of the transfer section.

Fig. 56 is a detail perspective of a transfer section.

Fig. 57 is a detail perspective of digit wheel trip on transfer section.

Fig. 58 is a detail perspective of the complement locking control mechanism during first and third operations.

Fig. 59 is an elevation of the structure shown in Fig. 58.

Fig. 60 is a detail perspective of minus total and addition-subtraction control locking device.

Fig. 61 is an elevation of the mechanism shown in Fig. 60, together with one of the parts cooperating therewith.

Figs. 62, 63, and 64 are views similar to Fig. 61 with the parts in different relative positions.

Fig. 65 is a detail of one of the individual correction keys showing the connection therewith of the splitting mechanism.

Fig. 66 is a sectional elevation substantially along the plane indicated by the line 66—66, Fig. 65.

Fig. 67 is a plan section along a plane indicated by the line 67—67, Fig. 65.

Fig. 68 is a plan view of two correction keys showing one key in splitting position as indicated by line on key.

Fig. 69 is a fragmentary vertical longitudinal section of keyboard, showing flexible keyboard mechanism.

Fig. 70 is a sectional elevation along the plane indicated by the line 70—70, Fig. 69.

Fig. 71 is a perspective view of one of the stop actuating yoke members.

Fig. 72 is an end view of the fractional digit wheel.

Fig. 73 is a front view of this wheel.

Fig. 74 is a plan view similar to Fig. 73, showing the adjacent units digit wheel and part of the machine.

Fig. 75 is a perspective view of a portion of a printed sheet showing the addition of fractions.

Fig. 75[a] is a view similar to Fig. 72 but showing a device having two transfer actuating projections and stops and corresponding to a keyboard having fifths keys instead of tenths or some other value.

Fig. 75[b] is a sectional elevation showing the digit wheel divided into 12ths.

Fig. 76 is an elevation of one of the racks showing the mechanism for increasing the speed in transferring.

Fig. 77 is a view similar to Fig. 76 showing the actuating of the mechanism during the transfer operation.

Fig. 78 is a transverse section substantially on the plane indicated by the line 78—78, Fig. 79.

Fig. 79 is a plan section substantially along the plane indicated by the line 79—79 Fig. 76.

Fig. 80 is a transverse section substantially along the plane indicated by the line 80—80, Fig. 81, and showing the means for preventing the carriage from relocking when control on keyboard is operated.

Fig. 81 is a sectional elevation substantially along a plane indicated by the line 81—81, Fig. 80.

Fig. 82 is a view similar to Fig. 81, but showing the parts in full actuated position.

Fig. 83 is a vertical section substantially along the line 83—83 of Figs. 2 and 2[a], showing the mechanism controlled by the year dating key.

Fig. 84 is substantially the same as Fig. 6, but includes interlock mechanism and mechanism for returning the non-add control.

Fig. 85 is a fragmentary view of part of Fig. 84, showing total and sub-total controls locked, and the return of the repeat key by the total or sub-total control.

Fig. 86 is a perspective view of the locking device between the addition-subtraction control and the minus total control.

Fig. 87 is an elevation of the improved type holder.

Fig. 88 is a section along line 88—88, Fig. 87.

Fig. 89 is a perspective view of the typebar.

In the accompanying drawings, forming a part of this specification, certain groups of elements will be referred to in general by certain letters, and then, together with other elements, will be described in detail. In these drawings, A refers to the accumulating mechanism, B the body of the machine in general, C the carriage, D the driving mechanism, E the electrical switch, F the fraction mechanism, G the guides, H the hammer section, I the indicating or dial wheels, K the keyboard, L the locking mechanism, M the motor, O the overdraft

mechanism, P the printing mechanism, R the ribbon mechanism, S the splitting mechanism, T the timing mechanism, and Y the year dater.

In the present structure, numeral 1 refers to any ordinary supporting stand upon which is supported the body B, carrying and supporting the various other elements of the mechanism. Hinged to the left side of the body B, as is customary, is a table 2 for supporting books or papers in connection with which work is being done.

The frame of the machine.

The body of the machine comprises a base 3 and right and left supporting frames 4 and 5 respectively, upon which are supported the other parts of the machine. As shown in Fig. 4, the base 3 is supported on the frame 1 and has fitted closely therearound a casing 6 to enclose the major part of the operative parts of the machine.

Resting upon the base 3 are the side frames 4 and 5, heretofore referred to, which are secured together by various transverse bars and shafts, the specific use of each of which will hereinafter appear. To the bottom 3 of the frame are secured castings 7 and 8, which support the timing mechanism and the drive mechanism. Secured to the rear portion of the frame and extending through an aperture in the cover 6 is the carriage mechanism C to be described in detail later. Besides the frame the body B includes various interlocks to be mentioned more specifically in their appropriate places. Carried by the casting 8 is the motor M having a drive shaft M^1, upon which is secured a worm M^2 in driving engagement with a worm wheel M^3, whereby the mechanism of this machine is driven.

Flexible key-controlling mechanism.

Aside from the year-dater key hereinafter specifically described, this is a 12 column machine in which each bank of keys is separately and independently removable from the frame, and since the mechanism of the banks is similar, a description of one may be taken as describing the mechanism of all. It may be noted in passing that counting from right to left each of columns 2–9 inclusive, consists of nine keys, numbered successively from one to nine, the zero being automatically printed in all columns to the right of any operated key, in which no key is depressed, unless the splitting mechanism is operated. At the forward end of each column is located a combined correction and splitting key 9, which carries an indicating mark 10, the purpose of which will later appear.

Referring to Figs. 10 and 65–71, 11 indicates the supporting plate of a bank of keys, to which is secured a cap plate 12, covered by some suitable soft covering substance such as felt, 13, whereby the spaces between the banks of keys are entirely closed against the entrance of dust and like substances. Upon the supporting plate 11 are secured the operating keys and the various operating means connected therewith. In Figs. 69 and 70, the structure of the operating keys is shown in detail. As here shown, the shank 14 of the key is provided on its rearward face with projections 15 and 16, and on one lateral face with a projection 17, preferably formed by bending over the lower end of the shank, while upon the forward edge near the top are provided a cam face 17^a and a stop member 34. As shown in Fig. 70, projection 17 is preferably, though not necessarily, provided with a groove for the reception of one end of the spring member 18, which is at its other end secured to a perforated projection 19, integral with or secured to a yoke member 20, having at one of its ends a transverse bar 21, the upper end of which is perforated for the reception of the bent-over end 22 of the stop wire 23, the opposite end of which is bent and rides in a slot 24 in a plate 24^a, as shown in Fig. 10. As shown in Fig. 71, the ends of the yoke are perforated for the reception of a pin 25, upon which the yoke is pivoted to the supporting plate 11. On this pin 25 and between the ends of the yoke is mounted a roller bearing 26, against which rests one edge of the shank 14, while between the yoke and the supporting plate is mounted a spacing member 27. The central portion of the yoke 20 rests upon and is tensioned against the projection 15 by the spring 18, but the shank is biased upwardly by said spring 18 by reason of the fact that the force of the spring applied to the lower end of the key bar or shank is transmitted to a point on the yoke farther away from the pivotal point than the projection 19. The lower end 28 of the crosshead 21 projects downwardly through slots in the flange 29 of a reciprocatively mounted plate or bar 30. Flange 29 performs the following functions; to wit, it acts on ends 28 to release any key in its column; it serves as a stop member to prevent keys from being depressed; it serves, when one key is depressed, to release any other key in the same column; it serves as a locking means to hold a depressed key in its lowered position until released.

Plate 30 is provided with a pair of keyhole slots for the reception of pins 31, carrying roller bearings 32, which act as supports for the plate and enable the same to be easily acuated. The keyhole slots make it possible in dismantling the machine to remove the bars 30 from their supports. This construction also makes possible the easy assembling of this part of the machine. As shown in Figs. 69 and 70, the flange of

flanged plate 33 is provided with slots in which the lower ends of shanks 14 slide, and by which said shanks are held from undue motion forwardly or rearwardly. The opposite end of the shank 14 passes through a slot in plate 12, in which it fits closely but yet slides freely. At its upper end, the key shank 14 is provided with a stop member 34, which engages the top of plate 12 or its covering member 13 to prevent the key from being depressed too far.

A reciprocatively mounted bar 35 is pivotally connected at intervals with supporting members 36, which permit the bar to have forward and backward motion when actuated by the cam surface 17^a acting on the roller bearings 37 mounted on supporting pins 38 or under the influence of a spring 39 (see Fig. 10). Connected to bar 35, as at 40, is a link member 41, having at one end a cam face 42 engaging a roller bearing 43, carried by a lever 44, which is pivoted at 44^a and is connected to the first stop wire 45. On the opposite side of the pivot 44^a and forming part of the lever 44 is a projection 46, to which one end of spring 39 is attached, while its opposite end is attached to a projection 47 on bar 41.

Pivoted to plate 11 by a pin 48 is a bar 49, (Fig. 10) which carries a pin 50 to which is connected near one of its ends a bar 51, which bar has at its opposite end fork arms 52 engaging a rod 53. When rod 53 is held in its uppermost position, the first stop wire 45 is withdrawn from it position as a stop member upon the actuation of any key in its column. Rod or link 51 is provided near its lower end with a slot, engaging pin 54, which serves to guide the link in its vertical motion. Slidably mounted on pins 50 and 54 by means of slots is a rod or link member 55, which has at its lower end fork arms 56, which engage a rod 57. This link member 55 carries at its upper end a cam-shaped member 58, which is normally in its lowered position, so that it does not engage the roller bearing 43, but which is actuated upwardly by rod 57, during the operations of taking a total, sub-total, minus total, or sub-minus total, with the result that wire 45 is drawn out of the path of sector arm 59 or rocker arm 60, as the case may be.

When touch bar TB (Fig. 2^a) is actuated to cause the operation of the machine, rod 53, which is normally in an elevated position, is lowered to permit levers 61 and 62 to be depressed. At the same time, rod 63 is elevated, which elevates pawl 64, pivoted at 65, so that shoulder 66 is raised to such a height that it cannot engage lug 67 on flanged plate 30. Because of this relative location of parts, if correction key 9 should be depressed while the machine is in operation, pawl 64 will not actuate plate 30 to release any key which is depressed.

Referring to Figs. 10, 12, 65 and 66, it will be seen that correction key 9, having a reduced lower extremity 68, is provided near its upper end with a shoulder 69, which abuts against the pin 70, mounted on plate 11, to limit the upward motion of the key under the influence of spring 71, attached at one end to the plate 11 and at its opposite end to a perforated lug on a reciprocatory bar 72, whose upper end abuts against the shoulder 69 and whose lower ends is pivoted at 73 to a bell crank lever 74, which is pivotally connected at 75 with plate 11, and at 65 with pawl 64, as heretofore stated. Bar 72 is guided in its reciprocating motion by a pin 76 on plate 11 and has a shoulder 77 to engage pin 75 to limit the downward motion of the key, which slides loosely in plate 12.

Castings 4 and 5 are secured together and held in proper assembled relation by bars 78, 79, 80, 81, 82, and 83, which pass transversely through the machine and are secured in position therein. Besides acting as tie members for the frame, these bars act as supports for various elements of the machine, as will be hereinafter set forth more fully. It will be seen by referring to Figs. 10, 12, 13, 14, 20 and 65, that bars 78, 79, and 80 are provided with grooves which encircle the same, to provide lateral supporting means for plates 11, which are suitably notched to fit around the bars and within the grooves. The plates 11 are locked in position by a key rod 84, which passes transversely through the plates and through suitable apertures in frame members 4 and 5.

Lever 61, as will be seen most clearly in Fig. 12 is provided with a shoulder 85 which may engage in a notch in flange 29 on plate 30 when, during the actuation of the machine, rod 53 is in depressed position, provided plate 30 has been forced backward during the clearing operation. Plate 30 will, therefore, be held in its actuated position so that no key may be depressed and then held in lowered position by the plate during the actuation of the mechanism. Also the faces of the flange slots abut against the extensions 28 to prevent stop wires 23 from entering slots 24 far enough to prevent the complete actuation of the sector arms 59 and rocker arms 60. It will be seen in Fig. 12 that lever 62 is pivoted at 86 to the plate 11 and that it has projecting from one end thereof a finger 87, which engages the flange 29 to actuate plate 30 against the tension of spring 30^a.

Special keys.

At the right of the banks or columns of ordinary numeral keys above described is a bank of fraction keys F to be hereinafter

specifically described, while at the left of the keyboard are three other columns of special keys, the one at the right including numerals from 1 to 9, the one at the left including months, and the middle one including three keys for printing numbers from 10 to 39, and six special character keys shown in the drawing as referring to "Invoice", "Balance", "Discount", "Due", "Credit" and "Debit". At the left of the December key is a year key YK, bearing the symbol 19, which may be used to print the first two numerals of the year, the other two numerals being printed by means of the figures indicated by the letters DK. It should be noted in this connection that the printing of any character or numeral in the first or third of these three columns does not result in the printing of any character to the right thereof, but that zero or any significant figure may be printed in the right hand column with 1, 2, or 3 in the middle column. It is noted that the keyboard mechanism of these three banks of keys has the same flexible construction as heretofore described in connection with the eight columns before described.

By referring to Fig. 9, it will be seen that the year-type is carried by the same carrier which carries the month-type. The year-key has certain special mechanism for locking the same in depressed position, for stopping the rocker arm 60 to the left of the machine in proper printing position, and for getting the first stop wire in the month-key mechanism out of the way of the rocker arm so that the type may be gotten into printing position opposite the hammer and for releasing the hammer mechanism so that printing may be effected.

The year-key shank 100 (see Fig. 83) is provided with lugs 101 at its lower end and 102 near its middle, which serve as stops to limit the upward movement of this key, which is guided in its vertical reciprocating motion by lugs 104 stamped out of plate 11, or by other suitable mechanism. This key shank also carries a cam 103, which engages a roller bearing 105, mounted on a lever 106, pivoted at one end to the plate 11 and provided at its opposite end with a fork 107, which engages a pin 108 extending through a slot in plate 11 and engaging bar 35 and carrying upon its opposite end a roller bearing 37 adapted to be engaged by cam 17^a.

Attached to the lug 102 is a spring, which is suitably supported and which acts to hold key shank 100 in elevated position when not otherwise held in a depressed position. Also connected to this lug by means of a pivoted link 109 is a lever 110, mounted at one end upon plate 11, and having at or near its opposite end a recess to engage a stop pin 111 mounted upon the left-hand rocker arm 60. Pivoted to the plate and having on one edge a lug 113 in a suitable position to be engaged by lug 101 is a lever 112, which is normally pulled forward by means of spring 114. Connected to the free end of this lever and adapted to be actuated thereby is the pawl 115, provided with a detent 116 adapted to be engaged by a bar 117 pivotally connected to a bar 118. This pawl also carries a lug 119 bent inwardly into position to be engaged by the back face of the lug 120 on bar 30.

When key 100 is depressed, lug 101 will be lowered beyond lug 113 and lever 112 will then be pulled forward by spring 114 into a position to lock key 100 in depressed position. When this key is depressed, lever 110 is naturally forced backward until its notched end comes into the path of stop pin 111 so that rocker arm 60 may rock a short distance before it will be stopped by the pin striking the lever 110 as indicated. By this motion, the hammer section is released so that the hammer may strike the year type 121 to accomplish the printing. The pressing of key 100 also retracts the first stop wire 45 of the left hand bank through the action of lever 106 and pin 108. During the actuation of the machine, bar 117, rocked about 118, strikes against lug 116 and pushes pawl 115 backward so as to release lug 101 from lug 113, in order to release key 100. In the event that the repeat mechanism has been actuated to prevent the clearing of the keyboard and cause the repetition of the item, the action just described will not take place and the year-key will not be released as indicated. The function of lug 119 is to serve as means for releasing key 100 by actuation of correction key 9 in the month column.

The fraction mechanism shown in Figs. 72–75^b is the same as that heretofore described except that the number of keys in the fraction column, the number of cogs in the dial wheel, and the number of teeth in the sector differ from that of the structure above described.

The location of the addition-subtraction, total, sub-total, repeat, and non-add controls is shown in Figs. 2 and 2^a to be at the right side of the machine, while the minus total and sub-minus total controls are shown in Fig. 2^a to be at the left side of the machine. The use of each of these controls will be briefly stated and then the structure will be recited in detail.

At the right of the machine, as shown in Fig. 2, is a carriage clutch control CC used to control the shifting of the carriage from right to left or left to right, and at the front of the machine to the left of the middle, as shown in Figs. 1 and 2^a, is a debit printing location control DC.

Controls to the right of the machine.

In the normal operation of the machine, it

is customary to actuate the total control lever TC and strike the touch bar TB so that one may be certain that no numbers are being carried by the dial wheels. The addition-subtraction control ASC is then actuated, which action returns the total control to its normal position and places the ASC lever in its adding position. Any desired date, character, or number may then be set up on the machine and the actuation of the touch bar will result in the placing of the numbers at the right of the date in the dial wheels and the printing of anything which has been set up, assuming that the non-add key NAC is in normal position. Other items may be added in the customary manner. If it is desired to subtract an item from something which is already in the machine, the item may be set up on the keyboard and the ASC lever pulled to its subtraction position, or vice versa. Pressing the touch bar TB will then cause actuation of the machine and the subtraction of the item set up from the sum previously in the machine. The number set up will be printed and the appropriate minus character will be printed adjacent thereto to indicate that this is a subtracted item. If the amount subtracted is greater than the amount already in the machine, or if an amount is subtracted when there is nothing already in the machine, the amount so subtracted will be printed as a minus item and the difference will be carried into the dial wheels as a complement, the overdraft sign shown in Fig. 54 and the subtraction sign being printed at the right of the number.

Assuming now that it is desired to print an item without adding it; this may be accomplished by pulling the non-add control NAC toward the operator and causing actuation of the machine by the use of the touch bar. As will be apparent, this will cause the printing of this item without adding it to or subtracting it from the amount already accumulated in the machine. At the time this item is printed, an appropriate symbol will also be printed to indicate that this quantity is a non-add item.

Adjacent the non-add control, shown also in Fig. 2, is the repeat control RC, the function of which is to cause the operation of the mechanism of the machine so that the clearing mechanism of the keyboard is not actuated to release the keys depressed. As is understood, the item set up on the keyboard will be retained so long as the repeat control is kept pulled toward the operator. It will be understood that in the matter of operation, the non-add and repeat controls are independent so that, if it is desired to repeat the printing of an item without adding it, this may be done by actuating both the repeat an non-add controls. It should probably also be stated that the repeat control may be actuated with the addition-subtraction control in either of its positions, but that for the use of the non-add control the addition-subtraction control must be in adding position.

Referring now to Fig. 2ª, if it be assumed that one or more items have been accumulated in the machine and it is desired to find the accumulated total, it is merely necessary to pull the total control TC toward the operator, which action automatically sets the ASC control in subtraction position. If now the touch bar be actuated, the machine will print the accumulated total, and the dial wheels will be re-set to zero. If, however, it is desired to print the total without changing the setting of the dial wheels, the sub-total control STC should be actuated before actuating the touch bar. This will result in the printing of the accumulated total without clearing the dial wheels.

If it should happen that an item subtracted is greater than the accumulated total in the machine, and it is desired to find out by how much the machine has passed zero, this can be accomplished by actuating either the minus total or the sub-minus total and then actuating the touch bar. If the minus total control be actuated, the amount by which the machine has passed zero will appear in the set of dial wheels nearer the operator, (see Fig. 2), while the farther set of dial wheels will show zero. Touching the touch bar TB again will result in clearing the dial wheels nearer the operator, which show the net credit or overdraft (the amount by which the machine has passed zero).

If, instead of operating the minus total control, the sub-minus total control SMC had been operated, the setting of the dial wheels in the first operation would be the same as in the first operation of the preceding illustration, but upon touching the touch bar again, the overdraft or net credit dial wheels would be returned to zero and the dial wheels remote from the operator would again be set to show the amount carried by them before the first actuation of the machine for the purpose of determining the overdraft or net credit.

If it is desired to separate debit and credit items, or subtracted and added items, printing the same in separate columns, the control on the front of the machine, marked DC, will be moved either to the left or right, as shown by the dotted lines in Fig. 2ª. This will then determine whether the subtracted items are to be printed at the left or the right and the added items at the right or the left. To accomplish this separation of items, it is necessary to actuate the carriage clutch control CC to one end of its path of travel or the other so that the clutch will be thrown in and the motor which actuates the carriage may cause it to be moved in the appropriate direction, provided pawl 907 is re-

leased to engage ratchet 908. The ASC lever will be placed in the appropriate position for adding or subtracting and the shifting of this lever will release the carriage for reciprocations, as will be explained later in connection with the detail description of the "Shifting mechanism for the carriage". The shifting also releases pawl 907 to engage ratchet 908. When the proper item has been set up on the keyboard, the touch bar will be actuated and the item will be printed in its appropriate place and with the appropriate sign, if it is a subtracted item.

Detail of addition and subtraction mechanisms and operation.

Assuming the addition-subtraction control lever to be set in the position shown in Figs. 5 and 6 for the addition of a number, the parts are connected as shown. The ASC lever is provided on its lower side with a projection 122 carrying a roller bearing 123, which may operate in the Y-shaped fork 124 of the elongated lever 125, pivoted at 126. The ASC lever also has on its lower end a cam 127, which is engaged by a roller bearing 128 carried by a lever 129, pivoted at 130. The purpose of this lever 129 is to act as part of an interlock mechanism to prevent the actuation of the machine by the touch bar before the ASC lever reaches its extreme position for addition or subtraction and to prevent the ASC lever from being actuated while the touch bar is in depressed position. This is accomplished by the lower end of lever 129, which has a flat face 131, engaging a roller bearing 132 on lever 133, pivoted at 126, (see Figs. 3, 5, and 6).

This lever 133 has secured to its forward end by rivets or equivalent means 134, a stop 135 (Fig. 4) adapted to interlock with bell crank lever 136 pivoted at 130, one of whose ends is connected to link 137 and whose other end is engaged by the bar 138 connected with the touch bar TB. The opposite end of link 137 is connected to one end of a similar bell crank lever 139 pivoted at 140, and whose free end is engaged by another bar 138a connected with the touch bar. When the ASC lever is actuated, cam 127, acting on roller 128, rocks lever 129 on its pivot 130, which in turn rocks lever 133, lifting interlock bar 135 into position opposite bell crank 136, whereby to prevent the rocking of this lever and consequently prevent actuation of the tripping mechanism. When the actuation of the ASC lever has been completed, lever 133 again resumes its lowered position so that stop 135 cannot prevent the actuation of the touch bar. Similarly, if the touch bar is depressed, the lug on bell crank lever 136 will rest above interlock bar 135, so that it will be impossible to actuate the ASC lever.

The connection from the mechanism just described to the tripping lever will be later described. (See "Driving mechanism.")

Lever 125, pivoted at 126 as previously indicated, has at its back end a pivotal connection 141 with one end of the link 142, whose other end is pivoted at 143 to link 144, the opposite end of which is pivoted at 145 to a spring actuated member 146, pivoted at 147 to the frame casting 4. (Figs. 3, 5 and 6.) Carried by this same pivot 147 are three other pivoted members 148, 149 and 150, (Fig. 3) the first of which has a lug 151 adapted to engage the other two alternately. These latter are biased toward each other by the coiled spring 152, whose ends extend away from the coil and engage lugs on the ends of members 149 and 150 respectively.

It will therefore be seen that when member 148 is oscillated about its pivot 147, the lug 151 will alternately engage members 149 and 150 to put the spring under tension so that the ends of said members will force pivot member 145 to move in one or the other direction, carrying with it link 144 and any mechanism connected therewith, (Fig. 6). This results in rocking member 153 about its pivotal point 154, which motion carries member 155 upwardly or downwardly against the face of the cushioning stop member 156. Member 155 has in its body portion a slightly S-shaped slot 157, in which rides a roller bearing 158 on lever 159, which is secured to shaft 160. This shaft 160 has secured thereto arms 161 carrying at one end a rod 162 (Fig. 5) on which is mounted the dial wheel mechanism 163. The object of this rocking of parts 159 and 161 is to carry the dial wheels alternately into engagement with the sectors 355 and stop fingers 164. The operation of the dial wheel mechanism will be described in detail later.

The oscillation of member 153 and of the mechanism connected with it and with the dial wheels is only possible when the relative arrangement of rocking member 146 and parts cooperating therewith is such that rocking of this member may take place. At the lower end of member 146 is a roller bearing 165 which cooperates with an arcuate stop member 166, which prevents the actuation of this member by the spring 152 until one end or the other of the stop member has passed the roller bearing 165. This stop member 166 is carried by a plate 167, which is connected thru a train of gears and link mechanism with the main driving mechanism.

When the ASC lever is rocked from the adding position, shown in Fig. 6, to the subtracting position shown in Figs. 3 and 33, roller bearing 123 will engage the upper arm of fork 124 and rock lever 125 into its other

operative position, in which its rear end is lowered, carrying with it link 142 and pivotal member 143. When the roller bearing carried by pivotal member 143 passes the pivotal point 154 it causes members 153 and 155 to move with a snap action into the other position assumed thereby. This snap action therefore naturally results in a quick movement of the dial wheels from engagement with the stop fingers 164 into engagement with sectors 159 or vice versa.

When member 125 provided with cam face 168 (Figs. 5 and 6) is rocked so that face 168 comes into engagement with pin 169, rack member 170, provided on one edge with teeth 171, is rocked slightly about its pivot 172, on which it is loosely mounted. A stop member 173 is carried at one end of arm 174, at the opposite end of which is mounted the type holder 175 for the indicator type used to print symbols indicating what operation has been performed. This arm is loosely mounted upon shaft 176, upon which are splined various spools and other members to be later described in detail (see "Friction drive mechanism"). It will be seen from the above description that when member 170 is rocked about its pivot slightly, lug 173 will be permitted to drop into the next notch, and if rocked further, it will be permitted to drop into other notches lower down, thereby permitting the type holder 175 to rise and place the appropriate type bar in position before the hammer to print the appropriate symbol. Arm 174 is provided at its inner end with a stop finger 177, which engages rod 80 to limit the upward motion of this arm.

On lever 125 are two stop members 178 and 179, which respectively engage shaft 172 and pivot pin 180 to limit the downward and upward motion of the arm. Carried by arm 125 is a pin 181 (Figs. 5, 6, and 33), which normally engages a projection 182 on a locking member 183, which is provided with a downwardly extending finger 184, having stop member 185 to engage with a lug 186 on pivoted member 146. When arm 125 is lowered by the shifting of the ASC lever, projection 182 will follow the pin for a short distance, thereby throwing finger 184 forwardly until its lower end engages a pin 187, carried by member 167. During a stubtraction operation, the top portion of member 167 rocks forwardly, taking pin 187 out of engagement with finger 184, thereby permitting stop lug 185 to engage lug 186 when same is lowered and hold same in depressed position until pin 187 comes back and pushes finger 184 rearwardly to release lug 186 from 185, it being understood that member 183 is pivoted on stop pin 180.

Carried by arm 125 is a pin 188, which is moved upwardly beyond the point of lug 189 on arm 190, by throwing the ASC lever into the subtracting position. This makes possible the operation of the overdraft controls when the machine has passed zero by a subtraction operation. (See "Detail of the minus totaling mechanism.")

Assuming the ASC lever to be pulled into subtraction position, the forward end of lever 125 will be rocked upwardly, and its rear end downwardly, whereby the parts will be set for a subtracting operation, as indicated heretofore. Having now set up an item on the keyboard to be subtracted from the accumulated total in the machine, the touch bar is actuated to cause the operation of the machine. This releases the trip mechanism and permits the actuation of link 191 by the main drive mechanism. The reciprocation of this link oscillates the geared sector 192 upon its pivot 193. Sector 192 is geared to sectors 194 and 195, which results in the actuation of these sectors to operate sector arms 59, rocker arms 60, and arm 174 on shaft 176, in the event that these members should be released for operation. Member 167 is secured to and oscillated with sector 195, and carries with it shaft 196, to which is secured cam member 197. This cam member 197 has mounted upon it roller bearing 198 (Figs. 5 and 6), which engages finger 199 on rocker arm 200, carrying at its ends shafts 53 and 63. Rocker arm 200 has another finger 201, to which is secured one end of a coiled spring to rock same in one direction about pivot 126, the other end of the coiled spring being secured to member 202, which rocks keyboard clearing shaft 117 about shaft 118.

The rocking of member 197 about its pivot causes the raising and lowering of finger 199 and with this the raising and lowering of shafts 53 and 63. The purpose of this is set forth in connection with the description of the keyboard mechanism shown in Figs. 10 and 12. With the ASC lever in subtracting position, the dial wheels are in mesh with sectors 355 and the downward motion of these sectors will rotate the dial wheels backwardly to subtract from the accumulated total in the machine the amount set up on the keyboard.

As link 191 starts downwardly, pulling with it the operating member 209 of sector 192, it also pulls downwardly pin 210, which is engaged by one end of a bell crank lever 211, pivotally connected at 212 with a link 213 and oscillating upon shaft 193. Link 213 has a pair of lugs 214 which engage a stop pin 215 in order that the motion of the link may be limited to the appropriate amount. The opposite end of link 213 is pivotally connected at 216 to a plate 217, fixedly connected with a shaft 218, upon which is mounted a lantern 219, (Figs. 10, 13 and 15) comprising rods 220 and 221. The oscillation of lantern 219 in one direc-

tion unlocks the transfer mechanism and releases sectors 355 from the lantern so as to permit a transfer to the dial wheels. Oscillation of this lantern in the opposite direction restores the sectors to normal position, and sets up the transfer mechanism for the next actuation thereof.

When the sector arms 59 and rocker arms 60 and 174 reach their lowermost position as determined by the position of their respective stops, the hammer mechanism will be released to strike respective type bars to cause the printing of the appropriate numerals and characters. Actuation of the hammers is caused by the oscillation of cam 197, the cam face of which strikes the roller bearing 203 to cause the rocking of member 204 about its pivot 205. By the rocking of member 204, pawl 206 is pushed rearwardly and its lug 207 engages pins 208 (Fig. 5). The construction and operation of the hammer section will be given later. (See "Hammer section.")

Plate 167 carries a roller bearing 222, which is engaged by a fork 223, forming a part of arm 148. The oscillation of plate 167 therefore rocks arm 148 so that lug 151 tensions spring 152. As plate 167 oscillates, flange 166 rides down one side of roller bearing 165 and prevents the rocking of arm 146 until the opposite end of flange 166 has passed roller bearing 165, whereupon the tension of spring 152 causes arm 146 to rock, with the result that the dial wheels are taken out of mesh with the sectors 355 at the completion of their downward stroke, as heretofore set forth. At this point in the operation of the machine, the printing takes place. Substantially coincident with the completion of the printing operation, link 191 reverses its direction of travel and consequently reverses the direction of rotation of sectors 192, 194 and 195.

The operation of the mechanism during addition is similar to that described for subtraction, except that, owing to the change in position of certain of the elements, as heretofore indicated, the dial wheels are out of mesh with the sectors 355 during their downward stroke and in mesh during their upward stroke, whereby the dial wheels are actuated positively instead of negatively.

Repeat mechanism.

When the repeat control RC (see Figs. 5, 6, and 14) is pulled forwardly, oscillating about its pivot 224, the finger 225 will be moved backwardly and will take with it link 226, pivotally connected at 227 to the finger. The opposite end of this link 226 being pivotally connected at 228 to lever 229, causes it to be rocked about its pivot 230, throwing cam 231 to the opposite side of roller bearing 232. This operation forces roller bearing 232 and rocker arm 233, which carried it, (Fig. 3) downwardly, oscillating the arm about pivot 234. The bottom face of this arm rests upon and presses downwardly the shaft 235, connected to a pair of levers 236 and 237, pivoted on shaft 234. The lever 236 has an arm 238 extending rearwardly to engage roller bearing 132, to cause an interlock, as explained. The rocking motion of lever 229 is limited by a stop lug 229[a].

Projecting rearwardly from lever 229 is an arm 239, which is bent intermediate its ends and provided at its free extremity with a bent over portion 240, forming a flange which engages spring held pawl 241, so that the same may be depressed (Fig. 5). This causes the lug 242 to be freed from pin 243. As a result of this, rod 117 is not caused to be actuated about shaft 118 to clear the keyboard and, since the keyboard is not cleared, the previous setting is retained and is repeated by the actuation of the touch bar.

Non-add mechanism.

When the non-add control (see Figs. 5, 6, and 14) is pulled forwardly about its pivot 224, the pin 244, to which are connected links 245 and 246, is oscillated rearwardly and actuates correspondingly the links. This pin 244 is carried by lever 253. Link 246 is connected at 247 to lever 248 and consequently rocks it about its pivot 230. This lever has projecting upwardly therefrom a pair of yoke arms 249, which cooperate with lug 229[a] to limit the rocking motion of the lever, the rearward yoke arm being extended to such a point that when the lever NAC is rocked forwardly, it will serve as a stop to prevent the actuation of the ASC lever to subtracting position. This projection also cooperates with the ASC lever to prevent the non-add control NAC from being pulled forwardly when the ASC lever is in subtracting position.

At its lower end, lever 248 is provided with arrowhead cam member 250, which cooperates with a roller bearing 251, corresponding to roller bearing 232, and carried by an arm 252, corresponding to arm 233. These arms are held in their upward positions by suitable means, such as coiled springs. The action of these members 252 and rod 235 and the connected mechanism is described heretofore in connection with rocker arms 233.

Pin 244, carried by lever 253, has one end projecting into engagement with yoke arms on the non-add control lever. Link 245 has in its free end a slot 254, which surrounds a pin 255 carried near the upper end of rack 170. When link 245 is actuated rearwardly, it pushes rack 170 slightly backward to permit rocker arm 174 to be carried into a lower notch on the rack. This results in the setting of indicator type in position to be struck by the printing hammer.

When lever 253 is rocked rearwardly, its rearward extension or arm 256, carrying hook 257, moves downwardly so that said hook engages pin 258 on bell crank lever 211 to prevent the same from oscillating about shaft 193, when the main drive mechanism is being actuated. This prevents the operation of link 213 and thereby prevents the oscillation of lantern 219.

On the side of pivot 180, opposite from pin 244, is a hook 259 forming part of lever 253. When the non-add control lever is actuated, this hook 259 is moved forwardly into a position in the path of flange 186, to prevent the actuation of lever 146, thereby preventing the dial wheels from being thrown into engagement with sectors 355.

Totaling mechanism.

When the total control TC is pulled forwardly about its pivot 260, it actuates both the totaling mechanism and the subtraction mechanism, this latter being caused by pin 261 pulling link 262 backwardly. This link is pivoted at its forward end to the ASC lever, and has in its rearward end a slot 263, which rides over pin 261 when the total control is returned to normal position as well as when the ASC lever is itself pulled into subtracting position. Projecting from a forward edge of the total control lever is an arm 264, having an S-shaped slot 265 and carrying a pin 266 in its extremity. The purpose of this pin will be explained later.

Riding in the slot 265 is a roller bearing 267, carried on a pivoted lever 268 on shaft 269. The opposite end, 270, of this lever engages a pin 271 fixed in the rocker arm 272, rigid with shaft 269 (Figs. 5, 6, and 14.) When this rocker arm is raised it carries with it rod 57, engaging yoke arms 56 (see Fig. 10). When rod 57 is actuated upwardly, it causes cam 58 on bar 55 to engage roller bearing 42 on lever 44, thereby withdrawing the first stop wire from a position in which it would obstruct the motion of sector arms 59 and rocker arms 60.

The end of rocker arm 272, extends upwardly and rearwardly, and near its extremity carries a pin 273. When this pin is carried upwardly with the rocker arm it engages a cam face 274 on an extension 275 of rack 170, thereby rocking the rack about its pivot 172. This actuates the rack backwardly to an extent which permits arm 174 to come down until the flange 173 engages one of the notches of the rack, thereby stopping the type carrier 175 in such a position before the hammer section that the appropriate indication will be printed to indicate that a total has been taken.

Carried by the total control lever TC near the slot 265 is a pin 276. This pin is straddled by a yoke on link 277, which is pushed downwardly by pulling the total control lever forwardly. ~~At~~ its lower end, this link 277 is pivoted at 278 to a member 279, pivoted at 280, which carries rearwardly the transversely-extending bar 281 when the total control is pulled forwardly. This rod 281, in its backward motion, strikes a lug 282, carried by reciprocating bar (Fig. 10), thereby pushing the same rearwardly and causing the apertured flange 29 to engage the lower extensions 28 of crossheads 21, thereby preventing any of the stop wires from interfering with the downward progress of the sector arms 59 and rocker arms 60.

Referring now to Fig. 13, it will be seen that when rod 57 is actuated upwardly, during the taking of a total, it comes into contact with a cam 283, carried by a lever 284, pivoted at 285 and having at its opposite end a stop lug 286, which is normally in the path of a pin 287, carried by left-hand sector arm 59. However, when a total is being taken, this lever is rocked on its pivot so that lug 286 is moved out of the path of pin 287, allowing the sector referred to to move downwardly as far as the dial wheels will permit. This sector arm 59 and its associated dial wheel do not correspond to any of the banks of keys, and the function thereof is to accumulate and print as part of the total any amounts transferred from the dial wheel corresponding to the last one of the banks of keys. This dial wheel will be hereinafter referred to as the accumulating dial wheel. Lever 284 is held in its normal position by any suitable means such as spring 288. Pivotally connected at 289 with the total control lever is a link 290, having in its opposite end a slot 291, which rides over a pin 292 mounted in lever 293 (see Figs. 3, 5, 6, and 22). This lever 293 carries on one side a pair of stop members 294, adapted to engage a shaft 295 to limit the rocking motion of the lever. The upper extremity of this lever has a plurality of cam faces 296 and 297, and roller bearing 298 mounted on rocker arm 299 cooperates with these cam faces to cause oscillation of shaft 300. Loosely mounted upon this shaft is a bell crank lever, comprising arms 301 and 303, adapted to swing with rocker arm 299 into a position with arm 301 above pin 302, on plate 217, thereby preventing the oscillation of the lantern 219. Arm 303 has at its outer extremity a lug 304, the purpose of which will be explained in connection with the complement mechanism. Members 299 and 301 are connected by a spring 305, the purpose of which is to cause arm 301 to follow roller bearing 298 when the same is actuated rearwardly by the cam faces on lever 293.

Opposite each one of the dial wheels is a stop member 306, (Fig. 5) rigidly connected with shaft 300, which is, by actuation of said shaft, caused to assume a position in

front of a stop member 307 (Figs. 9 and 22) forming a part of each dial wheel mechanism. The purpose of this is to cause the dial wheels to stop at zero during the operations of taking a total, minus total, sub-total, or sub-minus total. Since, in taking a total, the subtraction lever is pulled and the dial wheels are returned to zero, the operation of taking a total may be considered in part a subtraction operation, and in both of these operations, the stops 306 and 307 cooperate to set the dial wheels at zero. At this time the hammer section is operated to print whatever number was carried by the dial wheels.

Sub-totaling mechanism.

When the sub-total control STC is pulled forwardly above its pivot 260, the roller bearing mounted on pin 308, carried by the lower extremity of this control, engages cam member 309 on the rack 170 to rock same into such a position that an appropriate symbol will be printed to indicate that a subtotal has been taken. This roller bearing also reaches a position above a stop member 310, carried by member 146, whereby to prevent the dial wheels from being moved out of engagement with the racks as heretofore explained, thus preventing the clearing of the dial wheels. It will be noted that a pin 311, carried by the total control, projects laterally in front of the sub-total control lever, so that when the same is pulled forwardly it causes the actuation of the total control and the addition-subtraction control. The end 312 of the sub-total control lever upon which pin 308 is mounted is provided with cam faces, which engage a pin 313 on arm 314 to cause an interlock of the mechanism whereby to prevent any actuation of the machine until the sub-total control reaches its extreme position.

Details of the minus totaling mechanism.

Figs. 60 and 64, inclusive, show various positions of certain interlock mechanism for controlling the operation of the minus total control MT. In Fig. 60, the parts are shown in normal position when the ASC lever is set for addition. Fig. 61 shows a side view of the same parts with the addition of certain parts mounted on and controlled by the ASC control, the parts being in addition position. Fig. 62 shows part of these same parts with the ASC lever in substraction position. Fig. 63 shows the same parts in the same position except that the minus total control has been pulled, causing the locking of certain parts. Fig. 64 shows the position of the parts of Fig. 60 which are not shown in Fig. 62 when a subtraction operation has caused the machine to pass zero; this is the position of these parts before the minus total control MT has been pulled. Assuming the machine to have passed zero by reason of the subtraction of one or more items, and assuming that the ASC lever is in subtraction position, which it must be in order to determine the minus total or net credit, the parts will be in the position shown in Fig. 62. As soon as the minus total control MT is pulled, the parts will assume the positions shown in Fig. 63 and the parts shown in Fig. 64 will occupy the positions there shown. The action of these interlock members will be later explained. (See "Actuation of negative interlocks".)

When the ASC lever (Figs. 5 and 6) is pulled to subtraction position (shown in Fig. 3), roller bearing 123 not only pushes the fork 124, as explained, but also engages a cam face on arm 190, secured to sleeve 315, causing the rotation thereof about shaft 316. (See also Figs. 60–63.) Secured to the opposite end of this sleeve is a member 317, which is caused to be moved in the same direction and to the same amount as member 190. This motion takes the flat end 318 of member 317 out of the path of pin 319 carried by the minus total control MT so that it is possible for this member to be pulled so soon as the operation of the machine pulls lever 320 out of the way of pin 319. This will happen when, by reason of a subtraction operation, the machine has passed zero, the actuation of lever 320 being caused by a link 321 connected through a pin 322 to the lever. (See also Fig. 15.) The connection of the other end of this link will be referred to later. (See "Actuation of negative interlocks".) Lever 320 is secured to shaft 316, which has secured to its opposite end a locking lever 323, provided with a flat end 324, adapted normally to occupy a position out of the line of movement of pin 266, but to get into this line of movement when the mechanism is actuated by link 321, thereby locking the total and sub-total controls so that the same may not be pulled. The movement of parts 317 and 320 is in part controlled by springs 325 and 326 respectively, the latter being connected to a finger 327 on a rocker arm 200ª at the left side of the machine, corresponding to 200 on the right side. This rocker arm is pivoted on a pin 328 mounted on the left frame member (Figs. 14, 15, and 18). It should be noted that when the ASC lever is pulled to subtraction position, pin 188 (Figs. 5, 6, and 62) is placed in a position above but out of line of shoulder 189 on locking lever 190, so that when this lever is actuated by the minus total control MT, the shoulder will come below pin 188 as shown in Fig. 63, thereby preventing the actuation of the ASC lever to addition position.

Transfer mechanism.

By referring to Fig. 5, it will be seen that

the parts are in position for addition, and, as heretofore stated, when the ASC lever is pulled into subtraction position, the dial wheel mechanism having rod 162 mounted in arms 161 is pulled downwardly carrying with it the dial wheels 163, which engage the sectors 355 for the subtraction of any number set up on the keyboard, as heretofore pointed out. Assuming that when the parts are in this subtracting position, a greater amount is set up on the keyboard than has been accumulated in the dial wheels, and that a subtracting operation is performed, it will be seen that the number subtracted will be taken from the accumulated total, and that the dial wheel next to the left of the last one actuated because of the amount set up on the keyboard will be turned from zero to 9, and all dial wheels to the left of that one will also be turned to 9. The turning of these dial wheels to 9 is caused by the transfer mechanism to be now described. This transfer mechanism is denoted as a whole by reference numeral 329, and has a main supporting plate 330 (see Figs. 50, 56 and 57) upon which and by means of which the main part of the transfer mechanism is supported. The normal position of the parts of the transfer mechanism is shown in perspective in Figs. 56 and 57. It will be seen from these figures that the supporting plate 330 has secured to one side thereof a plate 331 and that between these plates are mounted several levers. Of these levers, 332 is pivoted at 333 and carries at one end a roller bearing 334, which, during the operation of the machine, is engaged by a tripping lug 335, carried by the dial wheel 336 of the dial wheel mechanism 163. When the lug 335 strikes the roller bearing 334, lever 332 is rocked about its pivot, whereby locking lug 337 is raised out of the path of projection 338 on a lever 339 pivoted at 340. Lever 332 is provided with a perforated projection 341 for the attachment of a spring, the purpose of which is to hold the end of the lever carrying roller bearing 334 normally in an elevated position and the lug 337 in a lowered position to enable it to engage and hold in locked position the projection 338 on the lever 339. Lever 332 is also provided with a projection 342, the operation of which will be later described. Also carried by this lever 332 is a projection 343, which serves in connection with a spacing pin 344 to limit the pivotal motion of the lever about its pivotal point. Lever 339 has a projection 345 adapted to be engaged by bar 220 of the lantern heretofore described, so that the lever may be rocked into position for projection 338 to engage 337. Lever 339 carries near its opposite end a roller bearing 346, which is engaged by a finger 347 of bell crank lever 348, pivoted at 349 (Fig. 50), the other arm 350 of this bell crank lever having in one edge thereof a notch 351, and at its extremity a perforated projection for the attachment of a spring 352, which has its other end secured at 353 to the sector arm 59. Roller bearing 346[a] of the left hand transfer mechanism corresponds to 346 of the other transfer mechanisms, but has a different function. The spring 352 will normally hold finger 347 of the bell crank lever in engagement with the roller bearing 346, so that when this roller bearing is permitted to move toward shaft 176, notch 351 will be moved away from pin 354, permitting relative motion between racks 355 and 356. During subtraction, the downward motion of the sector arm 59 is limited by stop wire 45, stop wires 23[a], or feather 357 on shaft 172, and the motion of sector 355 is thereby limited unless a transfer is to take place, in which event, (pin 354 and notch 351 being out of engagement) relative motion between sectors 355 and 356 is permitted, so that a transfer is made, owing to the action of the friction drive mechanism in connection with shaft 176. During addition, the upward motion of sector arm 59 and its connected sector 356 is limited by the engagement of lug 358 with shaft 80. If a transfer is to take place, lug 354 and notch 351 will be out of engagement and the friction drive will carry sector 355 one notch farther than sector 356, thereby completing the addition. At the end of this motion of sector 355, the dial wheel 336 is thrown out of engagement with the sector which is thereupon returned to normal position so that lug 354 engages notch 351.

Type-bar holder.

Sector arm 59 has at the opposite end from that carrying sector 356 a widened head 359 (see Figs. 5, 6, 10, 50, 50[a] and 87) constructed to carry the type carrier 360, which is similar in construction to the type carrier 175 heretofore referred to. Rocker arms 60 and arm 174 (Fig. 24) also have at their rearward ends a similar construction for supporting type bar carriers of the same form. These heads are provided with keyhole slots 361, adapted to engage rivets 362 secured to the type carriers which has mounted approximately centrally thereof a pin 363, which is engaged by a spring finger 364 carried by the sector arm, whereby the parts are held locked in assembled position. The type carrier is made from a punched sheet of metal bent over along parallel arcuate lines, the perforations in the metal occurring opposite each other in pairs and providing slideways for the type bars 365, which are actuated to retracted position by springs 366 and to extended position by the hammers 367 of the hammer section, the operation

of which will be later explained (see "Hammer section"). As will be seen in Fig. 50, the type bars are provided with lugs on one face to limit the inward motion thereof under the tension of springs 366, which are secured at one end to the type carrier and at their opposite end to lugs on the type bars.

Friction drive mechanism.

By referring to Fig. 24, it will be seen that the sector arms 59 and rocker arms 60 and indicator arm 174 are at their rearward ends offset to bring them into as narrow a compass as is consistent with efficient construction. By referring to Figs. 5, 6, and 11 it will be seen that these various arms are provided with non-circular, preferably with kidney-shaped, friction drive elements 368 arranged substantially symmetrically about the driving shaft 176. Connected to this shaft 176 by a feather 369 are various spools 370 and flanged sleeves 371. The friction members 368 referred to above are mounted in apertures in the sectors 355 and sector arms 59, and engage the flanges of members 370 and 371. These members are therefore normally driven with shaft 176 but when they strike an obstruction, they may remain in position as stopped. In the event that there is not sufficient friction between these parts, owing to wear or other cause, they may be tightened up by the mechanism shown in Fig. 11. It will be seen that shaft 176 is provided with a groove 372 into which fits a washer 373, open at one side so that it may be slid into the groove to prevent a flanged sleeve 374 from moving outwardly on the shaft. This sleeve is externally threaded and is engaged by an internally threaded sleeve which is provided around its periphery with means whereby it may be raised on the inner sleeve and caused thereby to advance along the shaft so as to move grooved sleeve 376 longitudinally against the tension of spring 377, the inner end of which rests against a flanged sleeve 378. Increasing the tension on this spring therefore increases the pressure in the friction drive mechanism so that there shall not be undue looseness. Washer 373 is put into position by forcing sleeve 374 on the shaft 176 until the washer can be slid transversely along the end of the sleeve into groove 372.

Transfer mechanism continued.

Pivoted at 379 on plate 330 is a lever 380, provided at its forward end with a notch 381, having on one side thereof a cam face 382 (Figs. 50, 56). The arm of this lever which forms the opposite side of notch 381 is provided with a cam face 383, adapted to be engaged by roller bearing 384 mounted on the rocker arm 59, when the latter moves upwardly during the operation of the machine. This lifts lever 380 so that bar 385 carrying a lug, to which is attached spring 386, may more readily be pushed backward by the oscillation of stop member 387, oscillating about shaft 388 (Fig. 50). Member 387 has a stop lug 389 adapted to engage stop 390, carried by the overdraft or net credit dial wheel 391. Member 387 also has a finger 392, which engages a lug 385ᵃ on bar 385 so as to push the same rearwardly when member 387 is oscillated.

Lever 380 is provided at its rearward end with a pair of lugs, one of which is turned over to furnish attachment for a spring 393, the purpose of which is to bias member 380 at its rearward end. This lever is also provided at its rearward end with a lug 394, which engages projection 342 on lever 332 to cause the release of the transfer locking mechanism.

Mounted in plate 330 and in oscillating member 397 respectively are pins 395 and 396, straddled by the forks at the opposite ends of bar 385. This construction permits of bar 385 being reciprocated longitudinally, as heretofore explained. The rear end of bar 385 is provided on its under edge with a recess 398, which normally rests above pin 399, carried by lever 339 on the adjacent transfer section. Normally the parts are in the position shown in Fig. 56, but when taking a minus total or sub-minus total, the parts are in the position shown in Fig. 50, in which the rear end of bar 385 is held upwardly by contact with pin 399. In this position of the parts, the rear end of lever 385 holds member 397 in the elevated position so as to prevent lug 337 from engaging finger 338 to lock the transfer mechanism. Plate 397 is pivoted at 400 and is limited in its oscillating motion by a pin 401, mounted on plate 330. This pin 401 also serves as a stop for member 380. It will be obvious from the drawing that plate 397 is provided with a cam face 402, which abuts lug 342 on the pivoted member 332. By reference to Figs. 50, 56, and 57, it will be seen that member 339 is provided at its forward end with an upwardly and forwardly extending projection 403, which is provided at its extreme end with a laterally offset finger 404, the purpose of which will be later explained in connection with the splitting mechanism.

By referring to Figs. 50 and 56, it will be seen that plate 330 is provided at its opposite ends with hooks adapted to engage shafts 80 and 81 respectively, and that it is provided with a perforation 405 adapted to receive wire or rod 84, which extends transversely through the machine to lock the parts to the frame. Also this wire 84 passes through perforations in the rear end of the key banks to hold them in place as

heretofore set forth. At the opposite ends of shaft 81 are rotatably mounted plates 407 supporting the opposite ends of a wire 408, which may be brought down to the rear of plates 330 to assist in holding the same in position Figs. 3, 5, 6, 10, 13, 21, 50.

Actuation of negative interlocks.

In Fig. 15 the parts are shown in normal position, either with nothing in the dial wheels or with a positive quantity accumulated therein. When this condition exists, neither the minus total lever MT nor the sub-minus total control SMT can be pulled, and the major portion of the construction shown in this figure does not enter into the normal operation of the machine. If now we assume that substraction operations are performed until zero is passed, it is understood that the accumulator dial wheel at the left side of the machine is caused to rotate one notch to show the figure 9. In this position, figure 409, carried by lever 410, pivoted at 411, drops down off cam 412, which rotates with the accumulating dial wheel 413. When this happens, pin 414 carried by lever 410 falls below shoulder 415 of lever 416, owing to the fact that this lever is actuated forwardly by mechanism to be described (see "Minus totaling mechanism, continued"). At the lower end of lever 410 is a finger 417, which engages pin 418 on lever 419, rigidly connected to a sleeve mounted upon stud 420. This sleeve also has rigidly connected to it an arm 421, one end of which has secured thereto a spring 422 to actuate the same rearwardly when finger 417 moves rearwardly. Also secured to this sleeve and extending forwardly therefrom is an arcuate arm 423 having in its forward end a pin 424, which serves as a pivot point for link 425. This link has extending therethrough a pin 425, which pivotally connects it to a pivotally mounted arm (see Figs. 15, 16, and 21). It will thus be seen that when arm 419 is rocked backwardly, link 425 will be pulled upwardly and will carry with it lever 427 pivoted at one end at 428 and having at its opposite end a hook 429, which engages pin 430, mounted on frame plate 431, pivoted on the shaft 193. The position of this plate, when the hook 429 engages pin 430, is shown in dotted lines in Fig. 22. A spring 432 coiled about pivot pin 428 has one end engaging pivot pin 426, and its opposite end engaging a hook 433 on one fork of a link 434. This spring therefore tends to hold link 434 in a lowered position with relation to link 425, but permits relative reciprocating motion between these links. As lever 427 is raised by link 425, hook 429 comes into the path of pin 430, as stated above, so that when frame plate 431, carrying this pin, is rotated clockwise about shaft 193, lever 427 is pulled rearwardly and pulls with it link 321, heretofore referred to, whereby locking member 320 is pulled out of the path of pin 319. Pin 428 is pivotally connected with relation to shaft 205 by means of an oscillating arm 435, which holds pin 428 and shaft 205 at a fixed distance apart and permits the former to oscillate about the latter.

Minus totaling mechanism (continued).

A link 437 has intermediate its ends a projection which is connected by means of pin 436 to link 434 (Fig. 15). At its forward end, link 437 is pivotally connected by means of a pin 438 to an oscillating member 439, while at its rearward end it is provided with a slot open at one side so as to have hook members 440, which are adapted to engage a pin 441, comparable to pin 430 and carried by frame plate 431. It will therefore be seen that when frame plate 431 rocks to the dotted line position shown in Fig. 22, pin 441 will be in position to be engaged by one of the hook members 440, as the rearward end of link 437 is moved upwardly by links 425 and 434. It will thus be seen that when frame plate 431 is oscillated in the opposite direction, pin 441 will push link 437 forwardly, causing member 439 to put a tension on a spring 442, coiled about pin 443 and having its opposite ends engaging hook members formed on member 445 and member 446, corresponding thereto. Member 439 is provided at its upper end with a finger 444 bent over to form a sort of flange, which extends between members 445 and 446 to transmit motion thereto from link 437. The upper ends of members 445 and 446 engage a pin 447 mounted in a plate 448, pivoted at 443. It will thus be seen that when pin 447 is held stationary, lug 444 actuates plate 446 forwardly, and tension is put on spring 442 which will cause pin 447 to be moved rapidly forwardly if the member carrying it should be released.

As heretofore pointed out, when a subtracting operation carries the accumulated total past zero, arm 416 moves forwardly (Fig. 21) and substantially simultaneously therewith, pin 414 moves downwardly. When lug 335 of the accumulator dial wheel strikes roller bearing 334 of the left hand transfer section (Fig. 50) roller bearing 346ᵃ, corresponding to roller bearing 346, is permitted to move downwardly toward shaft 176. This roller bearing has resting up against it an arm 449ᵃ (Fig. 21), pivoted to pin 449. This member 449ᵃ has projecting therefrom a short arm carrying a pin 450, which engages a finger 451 secured to a shaft 452. Secured to the right hand end of this shaft is a member provided with a hook 453, adapted to engage a pin 454, carried by a plate 455. Held in spaced relation to this plate by means of rivets is another plate of

the same form, and between these plates and pivotally secured thereto at 456 is a hammer 457, having at its upper end a head adapted to strike a special indicating type which prints the sign used to indicate that the amount opposite which the sign is printed has carried the accumulated total below zero. This special type is carried by a type-bar carrier or magazine mounted on an auxiliary arm which has an end bent over and secured to arm 174 as shown in Fig. 24.

Upon member 448 is mounted a roller bearing 458 normally resting against the cam face 459 on the forward end of arm 460 integral with arm 416, pivoted at 420 (see Figs. 15, 21, and 55). It will therefore be seen that when roller bearing 346^a drops to the dotted position shown in Fig. 21, arm 449^a will also move to the dotted line position and carry roller bearing 458 rearwardly to throw arm 416 out of the path of pin 414 thus permitting arm 410 to descend, thereby actuating the mechanism whereby the overdraft dial wheels are permitted to engage their racks. Secured to arm 449^a at 461 is a spring 462, which keeps the arm tensioned against roller bearing 346^a. Secured to plate 448 is a sleeve 463 to give lateral support to this plate to prevent same from undue play. Also secured to this sleeve 463 is an arm 464, having at one of its extremities a roller bearing 465, which engages link 437 when arm 464 is raised by the backward oscillation of plate 448. This insures that hook members 440 will be raised to and held in position to engage pin 441, and will be retained in engagement with this pin until the transfer mechanism has been re-set.

Assuming now that minus total control MTC is pulled from the position shown in Fig. 15 to that shown in Figs. 21 and 22, we see that link 466, which is pivoted to the control lever at 467, is pulled forwardly, and as it moves it carries with it its rearward pivot pin 468 out of the path of locking lug 469, which drops into position back of the pin 468 to thereby prevent the control lever from being restored to normal position until the operation of finding the minus total is completed. The form and operation of this locking lug will be seen by reference to Figs. 58 and 59, in which it is seen that the locking lug is connected to a plate 470 pivoted to pin 471. This plate is rocked forwardly by means of a spring 472, secured at its respective ends to pin 473 and hook 474, which latter is pivoted on shaft 475. Extending forwardly from the pivotal point of hook 474 is an arm 476 having on one edge thereof a cam face 477, adapted to be engaged by pin 468, heretofore referred to. It will be seen that when the pin moves forwardly, it will ride over cam 477, raising arm 476 and taking hook 474 out of engagement with the flanges 478 and 479, projecting laterally from plate 470.

Referring again to Fig. 15, it will be seen that the minus total control lever has extending from one side thereof a projection upon which is mounted a roller bearing 480 (shown also in Fig. 21). This roller bearing rests against a cam face 481 on member 448. When the minus total control is rocked about its pivot 482, the roller bearing rides over cam face 481 and permits lever 448 to be oscillated about its pivot 443 under the influence of spring 442. When this member moves forwardly, it carries with it pivot 447 and link 483, secured thereto. The rearward end of this link is pivotally connected at 484 to a lever 485, pivoted at 485^a and having upwardly and rearwardly extending arms 486 and 487, respectively. The upper arm 486 has an elongated, slightly S-shaped slot 488, in which rides a roller bearing 489 carried on the rearward end of a rocking arm 490, rigidly attached to shaft 295 to rock same, whereby arms 491, also rigidly attached to 295 at one end and having mounted therein at their opposite ends a shaft 492, carrying overdraft or net credit dial wheels 391, are caused to place the latter in mesh with or remove same from sectors 356. It will therefore be seen that pulling the minus total lever forwardly results in link 483 being pulled forwardly and roller bearing 489 being moved downwardly. This causes dial wheels 391 carried by shaft 492 to be moved down into mesh with sector 356 before the machine is turned over to determine the overdraft or net credit. On this side of the machine is a link 156^a, corresponding to link 156 on the right side of the machine and having shoulders against which arm 487 may strike and be cushioned in its movement up and down. The construction will be more evident by referring to Figs. 21 and 55, in which the link 156^a is shown provided with slots at its upper and lower ends, which may slide on pins 411 and 493 as arm 487 strikes the upper or lower shoulder. It will be seen in Fig. 55 that a thin leaf spring overlies the body member of this link and furnishes friction to retard the sliding of this member under the influence of arm 487.

The pulling forward of the minus total control MT also pulls forward a link 494 (see Figs. 15, 21, and 22), provided at its forward end with a pair of lugs 495 and 496, by reason of the engagement of these lugs with pin 467. Just slightly before the lever MT reaches the limit of its motion, roller bearing 480, carried by a projection on this lever, engages link 494 and moves the same upwardly about its pivot 497 to cause disengagement of the lug 496 from pin 467, so that the link may be returned

to its rearward position during the operation of the machine without shifting the control MT rearwardly. The pivot pin 497 is mounted in a bell crank lever 498, pivoted on a pin 499, mounted in the frame member 5. The other arm of this bell crank lever extends rearwardly and has at its extremity a cam face 500, and between this cam face and the pivot pin 499 a pair of pins 501 and 502, to which are secured the upper ends of a hook link 503 and a link 504 respectively. As pivot pin 497 is pulled forwardly, cam face 500 moves upwardly and is engaged by roller bearing 505 carried on the lower arm 506 of a bell crank lever rigidly connected to shaft 388 and having secured at its rearward end a spring to cause the actuation thereof. It will thus be seen that shaft 388 will be oscillated by reason of the co-action of the cam and roller bearing and that by reason of this, stop members 389 and fingers 392 are oscillated about their pivotal points, as heretofore explained. (See Figs. 10 and 22.)

It will be seen from the above that as the minus total control is pulled forwardly, link 504 is raised, carrying with it the pivot pin 507 at its lower end, which is connected to a rocker arm 508, rigidly connected to shaft 172, and causes the rocking thereof. This carries feather 357 out of the path of projection 358 on sector arm 59, so that the same may move down an additional distance equivalent to one notch of the sector. This is necessary in finding the overdraft or net credit in order to clear the overdraft or net credit dial wheels at the left of those in which appears the complement of the number in the dial wheels. It is also necessary in order to prevent getting in the overdraft or net credit dial wheels to the left of the first wheel a number in which the digits are one unit too large.

Rigidly connected to the right hand end of shaft 172 is a rocker arm 509 (Figs. 3, 5, 6) having at its lower rearward end a roller bearing 510, adapted to engage a cam face on an arm 511, rigidly connected at its lower end to a shaft 512, which carries an arm 513 provided at its end with a pin 514, which engages pawl 206 to move lug 207 from pins 208. The purpose of this is to prevent the actuation of the hammer section during the first turn over of the machine after the pulling of the minus total lever. Pivotally connected to the opposite end of this rocker arm 509 is one end of a link 515, the opposite end of which is pivotally connected at 516 to a lever 517 carrying stop member 518 and a cam 519. This latter engages roller bearing 298 and actuates the same, together with its supporting arm 299 and the stop members 306 (see Figs. 3, 22, 23, and 50). It will be seen that when the stop members 306 are raised to the position shown in Fig. 22, the stop members 307 on the dial wheels will be stopped when they strike against the end faces of stop members 306, whereby the dial wheels will be set at zero. The stop member 518, as will be seen from Figs. 3, 6, 23 and 37, is carried rearwardly to a position below the bent over end 304 of finger or arm 303 and prevents oscillation of the bell crank lever, of which this forms one arm. This therefore prevents arm 301 of this lever from getting in the path of pin 302, mounted in plate 217, which oscillates about shaft 218, thereby permitting the lantern to oscillate about its pivot. Shaft 300, carrying arm 299, has secured thereto a pin 520, to which one end of a spring 521 is attached. The other end of this spring is attached to link 159 and therefore tensions both arm 299 and link 159 forwardly. It is of course understood that the tendency of this tension is to hold stop members 306 out of the path of stops 307 and to hold dial wheels 163 out of engagement with sectors 355.

By referring to Figs. 15, 16, 21, and 22 it will be seen that hook link 503 is pulled forwardly when member 498 is rocked about its pivot 499. At the same time that this hook member is being pulled forwardly, lever 522 (Fig. 22) is oscillated about its pivot 449, by reason of the fact that pin 468, passing through link 466, is connected to lever 522. The forward end of this lever passes downwardly forcing hook 523 out of the way of pin 430, by reason of a connecting and spacing member 524, between member 522 and the plate 525, corresponding in contour to the forward end of lever 522, striking against a cam face 526 on member 503. After member 524 passes cam face 526, the hook is permitted to again move backwardly under the influence of spring 527 (Fig. 21).

The rearward end of lever 522 is formed with a cam face 528. Rigid with shaft 529 is a crank arm 530, having at one end thereof a stop member 531 to limit the pivotal motion thereof by reason of contact of the stop member with shaft 82, while at the opposite end is a roller bearing 532 (Fig. 21), which is forced upwardly by the top of lever 522, when the same is actuated about stub shaft 449. As will be seen in Fig. 21, this roller bearing at such time rides part way down cam face 528. The raising of lever 530 causes the shifting of the ribbon so that the amount of the net credit or overdraft will be printed in a distinctive color. The mechanism for accomplishing this will be described later.

Carried by plate 522 on its upper edge is a cam member 533 (Figs. 21, 22, 55, 58) adapted in the normal position of the machine to occupy a position below pin 534,

carried by rocking arm 535, secured to shaft 475. Also secured to this shaft is a locking member 536, at the right hand side of the machine, having at its upper end a shoulder 537 adapted to support a pin 538 on plate 155. The purpose of this locking of member 155 is to prevent said member from lowering and thereby causing dial wheels 163 to engage sectors 355. This operation takes place at the end of the first half of the first cycle of finding the overdraft or net credit. With pin 538 resting on the shoulder 537 and plate 155 locked thereby in raised position, the dial wheels will be held out of mesh with sector 355 until the minus total control is pushed back so that cam 533 rides under and raises pin 534 to its elevated position, thereby throwing shoulder 537 out from under pin 538, permitting same to drop to the solid line position, Fig. 22.

By referring to Fig. 22, it will be seen that minus total control MT is provided on its forward side with a projection which carries a pin 539 and is provided with an S-shaped slot 540. When the minus total control is pulled forwardly, this pin pushes downwardly on the inner end of the slot in link 541, and forces member 542, pivoted to link 541 at 543, to oscillate shaft 280, as explained in connection with the parts on the right side of the machine, whereby to prevent the setting up of anything on the keyboard. Member 542 is normally held in raised position by spring 544, one end of which is secured to a pin 545, which serves as a stop to limit the motion of the minus total control.

Riding in the slot 540 is a roller bearing 546, carried by a lever 547, loosely mounted on the shaft 269. The opposite end of this lever engages a pin 548, secured to an arm 549 supporting one end of rod 57 resting between the fork members 56 on the end of link 55, the purpose of this being explained in connection with the key board mechanism. It will be seen from Figs. 13 and 22 that when the minus total control MT or the sub-minus total control to be hereinafter referred to is pulled forwardly, shaft 57, in being moved upwardly, forces member 283 rearwardly, whereby projection 286 is taken out of the path of pin 287, thereby permitting the sector of the accumulating wheel to move downwardly. Reference is again made to the fact that the operations of totalling and sub-totalling actuate this mechanism to release the sector of the accumulating dial wheel. It will be seen from Figs. 15 and 22 that cam 550 on the lower edge of the minus total control actuates a roller bearing 551 mounted on the rear end of a lever 552, pivoted at 553 to cause the actuation of interlock mechanism heretofore referred to, one edge of the lever striking against roller bearing 554, carried by bell crank lever 237.

Subminus total control mechanism.

The sub-minus total control mechanism will be described with particular reference to Figs. 15, 19, 21, 35, and 36. It will be seen that when the sub-minus total control SMT is pulled forwardly to actuate this mechanism, it will be turned about its pivot 555 and will actuate links 556 and 557 and bell crank levers 558 and 559, being limited in its oscillating motion by stop 560. When link 556, having a slot 561, is actuated forwardly it will pull with it pin 467, carried by the minus total control, and will actuate this and the mechanism connected therewith as described above. When this sub-minus total control is actuated rearwardly the slot 561 will slide on the pin 467 without actuating the minus total control, as will be later referred to.

When link 557 is pulled forwardly, the slot 562 in the rear end of this link will slide over pins 563 and 564 mounted respectively on stop pawl 565 and the left frame member 5. Pin 564 serves as a guide for this link, and when the rearward end of the slot passes over this pin, the link will be forced downwardly carrying with it pawl 565. As this pawl is moved downwardly, its lower end is carried into the path of pin 447 to prevent rearward movement thereof, whereby actuation of lever 485 is prevented, thus preventing the overdraft or net credit dial wheels from being thrown out of engagement with sectors 356. This pawl 565 remains in this position until the lever SMT is restored, when it will be again thrown out of its locking position. On the right side of the machine is also a stop pawl 565[a], corresponding in shape to the pawl 565 but not being provided with a pin comparable with 563. These pawls are fixedly secured to a shaft 566 so that the rocking of shaft 566 by pawl 565 also rocks 565[a]. This pawl when rocked downwardly, serves as a stop member for pin 145, whereby this pin and its connected link 144 are prevented from rearward motion. This prevents shifting the dial wheel mechanism 163 and consequently holds these dial wheels in engagement with sectors 355.

At the lower end of lever SMC is a cam 568, which rides over roller 569, forcing the rearward end of the horizontal arm of bell crank lever 559 downwardly so that the stop member 571 rides under the cam. When the limit of motion of the control lever has been reached, roller bearing 569 will enter notch 570, but the end of stop member 571 will strike the edge of this cam, thereby preventing this bell crank lever from assuming normal position. Levers 558 and 559 are pivoted on stub shaft 572, mounted in the left side of the frame. The

lower end of bell crank 559 is pivotally connected to a link 573, normally actuated rearwardly by spring 574. At its rearward end, this link is provided with a slot which straddles shaft 205 and serves as a guide for this end of the link, which is provided with a pin 575, co-acting with a finger 576, secured to a shaft 577. At its opposite end, on the right side of the machine, this shaft has secured to it a stop member 578, which in normal position holds pin 579 downwardly, causing pawl 580 to be rocked about its pivot shaft 581 and to thereby be held disengaged from stop member 582, carried by disk 584, mounted on main driving shaft 585. Stop member 578 is biased rearwardly by a spring so that when link 573 is moved forwardly, the spring will cause the stop member to move rearwardly. Pawl 580 when released by the oscillation of stop member 578, rocks about its pivot 581 under the tension of a spring 583, as shown. Keyed to the main driving shaft 585 is a ratchet disk 586, which may be clutched to disk 584 upon the release of the spring held pawl 587 mounted on the disk 584. This pawl is rocked about its pivot 588 by engagement with the hook on the end of pawl 580 so as to unclutch the main driving shaft from the disk before the latter is stopped by the engagement of stop member 582 with pawl 580. As seen in Fig. 4, the normal position of stop member 582 when the machine is not in operation is in engagement with the lower end of the stop member 589. The function of pawl 580 is to stop the rotation of disk 584 and its connected mechanism at the end of a half cycle so that the numbers on the overdraft dial wheels may be read.

Pivotally connected to link 573 at 590 is a link 591 (see Figs. 15 and 35), having in one end a slot adapted to slide over a pin 592, carried by hook carrying member 503. This slot permits the movement of the hook carrying member, under the influence of member 522 out of position to engage pin 430 as previously pointed out. When link 573 is moved forwardly it carries with it link 591 which pulls on pin 592 and takes hook 523 out of the path of pin 430, whereby to prevent actuation of member 503 by the oscillation of this pin about pivot shaft 193.

Unlocking minus total control.

As shaft 193 is oscillated during the operation of the machine, member 431, carrying a pin 593, is caused to oscillate, thereby reciprocating pawl 594, which is carried by pin 593 (see Figs. 15, 22, 58 and 59). This pawl has, near its upper end, a projection 595 adapted to engage pins 596 and 597 mounted in member 470. At the first upward movement, this projection 595 engages under the upper pin 597, forcing the same upwardly until hook 474 engages upper lug 478. At this time, projection 598 on the lower end of pawl 594 strikes a projecting part of member 431 (Fig. 59) causing the upper end of the pawl to be thrown forwardly so that lug 595 disengages pin 597. As the pawl is returned by the oscillation of shaft 193, lug 595 rides over pin 596 and gets below same, so that upon the next reciprocation of pawl 594, member 470 is again moved upwardly until hook 474 gets below projection 479 when projection 598 causes the disengagement of 595 from 596. At this time locking member 469 is above pin 468 so that link 466 may be returned to its rearward position. A spring 599, attached at one end to pin 473, is attached at its opposite end by means of a pin 600 to pawl 594, whereby this pawl is normally biased so as to engage pins 596 and 597.

Hammer section.

In the description of the hammer section mechanism, reference will be made in particular to Figs. 5, 6, 9, 10, 12, 37, 38, 51 and 53, the latter being a section along the plane indicated by the line 53—53, Fig. 10. This section has a pair of supporting plates 601 and 602, provided with notches adapted to engage shafts 82 and 83. These plates are also perforated for the reception of a rod 603, which passes through means on the shaft 83, outside of plates 601 and 602 so that these plates are locked to shaft 83.

As heretofore stated, pawl 206 is provided with a lug 207 which engages pins 208. These pins are mounted on a plate 604, carried on a rotatable winged shaft 605. As pawl 206 is reciprocated it causes the rotation of this plate and the shaft 605. Inside of the hammer section, this shaft is provided with a plurality of wings 605ª, the function of which is set forth in the next paragraph. Passing through the hammer section is a rod 606, upon which the hammers 367 are mounted for oscillation. At its right end, this rod has secured a locking pawl 607 having a projection adapted to engage the pins 208 to prevent this mechanism from being rotated backwardly. This pawl engages the pins after the device has been carried forward its full distance and before pawl 206 starts on its return. Extending through the hammer section is a shaft 608, upon the right end of which is secured a lever 609, having a detent 610 adapted to engage pins 208 as the shaft 605 is rotated. This lever has mounted in its opposite end one end of a rod 611, extending through the hammer section and being mounted at its opposite end in a plate 612, also secured to shaft 608. As this shaft is rotated, rod 611 is forced downwardly against the lever 613 secured at one end to a rod 614 mounted in the hammer section supporting plates. These levers have each a shoulder 615 adapted to engage a

shoulder 616 on each hammer element 367 in order to prevent the hammer from being actuated. It will therefore be seen that when rod 611 is depressed, shoulder 615 will be taken out of the path of 616, thereby permitting the hammer to be actuated if otherwise free to move. Lever 613 has secured to its rearward end a spring which normally biases it upward, and projecting from its upper edge near the rearward end is a stop member 617, which is engaged by one end 618ª of a lever 618, pivoted at 619. This lever is biased about its pivot by the same spring used for the actuation of lever 613. It will therefore be seen that when rod 611 is forced downwardly, the end 618ª of lever 618 will move forwardly to take a position above the stop member 617 and prevent lever 613 from rising again, provided that lever 618 has been released for movement about its pivot 619. This release takes place when members 359 are moved upwardly with the downward motion of sectors 356 and rocker arms 60 and 174. End 618ª of lever 618 is normally held in a rearward position by members 620 on the ends of the levers, which will be permitted to rock about their pivots when members 359 are raised.

As shaft 605 is rotated, wings 605ª engage a cam face 621 of hammer element 367 and cause the hammer to be oscillated about its pivot 606 against the tension of spring 622, the upper end of which spring is secured to a plate 623 by means of which the tension of the spring may be adjusted. Pivoted in plates 601 and 602 is a shaft 623ª (Figs. 10, 12, 37, 38) to which are secured crank arms 623ᵇ, the ends of which engage the under side of plate 623 and force the same upwardly or let it ride downwardly as shaft 623ª, is rotated. Secured to one end of this shaft is an arm 623ᶜ, which is pivotally connected to a link 623ᵈ, coacting with the internally threaded collar 623ᵉ, mounted to move on a bolt 623ᶠ, rotatably secured in a frame 623ᵍ. It will be seen that as the bolt is rotated, it causes collar 623ᵉ to move longitudinally thereof and therefore causes link 623ᵈ to reciprocate. This results in fingers 623ᵇ actuating plate 623 as above set forth.

As wing 605ª is moved forwardly past the extremity of cam face 621, spring 622 causes the hammer element to move quickly about its pivot 606 so that the hammer head strikes a sharp blow on the end of the type bar 365. Adjacent cam face 621 is a projecting lug 624, adapted to be engaged by a locking member 625, pulled rearwardly by a link 626, provided with a slot 627. This link is actuated forwardly by means of a bell crank lever 628, pivoted on shaft 529 and rocked about this shaft by a rod 629, rigidly connected with the platen-carrying mechanism. It will therefore be seen that when the platen is elevated, rod 629 will be lifted to permit the actuation of bell crank lever 628 about its pivot under pressure from link 626, tensioned by spring 630. Pivoted in plates 601 and 602 is a shaft 631, to which is rigidly secured locking member 625 and a crank arm 632, the free end of which carries a pin 633 passing through slot 627. Passing through this slot is one end of a spring 634, coiled about shaft 631 and having its other end abutting against pin 633 to normally bias crank arm 632 to its forward position with relation to link 626.

Hammer elements 367, adapted when they are actuated, to strike the type bars are provided at one side with lugs 635, to engage the end of a reciprocable link 636 provided on opposite edges with notches 637 and 638. The lower one of these, 638, has resting in it the stop lug 617 of the bar 613 of the next hammer mechanism to the right, so that when bar 636 is forced downwardly, it carries with it bar 613 belonging to the next adjacent hammer, releasing same to strike the type bar. This functions only to cause the printing of zero to the right of any significant digit printed because of the setting of the machine.

In the ordinary operation of the machine, all of the hammers corresponding to the different accumulating dial wheels may be actuated, but hammer 457, corresponding to the special character type carrier, is by reason of hook 453 and pin 454, actuated only to print the sign indicating that the number opposite which it occurs has caused the accumulated total to pass zero in a subtracting operation (see Fig. 21). It should perhaps be noted in this connection that the depression of a month key does not result in the printing of any other character to the right thereof, and that in order to prevent the printing of a zero in the third column with the special characters in the second column, it is necessary to use the splitting key of the third column.

Splitting mechanism.

Below the mechanism just described is a series of reciprocable bars 639, biased backwardly by springs 640, each carrying a forked lug 641 (Figs. 10, 12, 51, 53). The arms of these forks engage the lower end of members 636 to force the shoulder of notch 638 forwardly so that it will disengage stop lug 617. Any one or more of bars 639 may be actuated forwardly by rotation of keys 9 to such a position that the indicating mark 10 extends transversely of the keyboard as shown in the lower part of Fig. 68. Referring now to Figs. 10, 12, 13, 40, 65 and 66, it will be seen that the extremity 68 of correction key 9 is offset at 642 and is then extended at at 643. This portion 643 is engaged by the arms of a yoke 644, which

is actuated by the rotation of the correction key, as will be evident. Secured to the flange of a plate 11 of the keyboard is a supporting member 645, which rests upon 5 and serves as an abutment for a collar 646, secured to shaft 68 (Fig. 65). The free end of plate 645 has secured to it one end of a spring, the other end of which engages a plate 647, bent at 648 to provide means to 10 engage a series of notches in the collar 646, whereby key 9 may be firmly held in any selected position. Upon rotation of key 9, plate 647 will be forced to yield downwardly, as will also shaft 235, which is 15 spring tensioned.

As correction key 9 is rotated, yoke 644 is forced rearwardly and causes the rocking of lever 649 about its pivot 650 to cause the reciprocation of bar 651 and link 652 (Fig. 20 13). The first of these has a pin 653, which slides in a slot in the lever 649 and abuts at its opposite end the turned over end 654 of lever 655 pivoted at 656. The lower end of this engages the turned over end 657 of bar 25 639 to cause the pulling forward thereof. When link 652 is pulled forwardly, it rocks lever 658 about its pivot 659 to cause the upper end 660 to engage the laterally bent end 661 of bar 662 and force this bar to 30 slide longitudinally on pins 395 and 663. Bar 662 is biased forwardly by a spring 664 and has at its reaward end a lug 665, which is forced into the path of lug 404 on the transfer mechanism, thereby preventing the 35 actuation of this transfer section. This causes the splitting of the dial wheels as the previously described mechanism causes the splitting of the hammer section.

40 *Ribbon actuating mechanism.*

In connection with the following description reference should be made to Figs. 2, 5, and 37–43.

Carried by section 192 which is secured to 45 the right end of shaft 193 is a projection 209, and secured to this is a projection 209[a]. Mounted upon one of the pins by means of which these parts are secured together is a roller bearing 666, which is engaged by the 50 arms of a fork 667, which is caused to oscillate by the oscillating movement of shaft 193 and sector 192. Fork 667 is carried by an arm 668 pivoted at 669 and carrying cams 670 and 671. Pivoted in the side cast- 55 ings of the carriage is a shaft 672 (Figs. 37, 39, 41) which carries at its right end a cross arm 673 provided near its ends with roller bearings 674 and 675, which engage cams 671. It will therefore be seen that as arm 60 668 is oscillated about its pivot, the roller bearings 674 and 675, engaging cams 671, will be rocked thereby and will cause the rocking of shaft 672, which has secured to it an arm 676 near the left side of the ma- 65 chine. This arm carries a pin 677 which engages in the forked end of a lever 678 pivoted at 679 (Figs. 37, 39). The upper end of this arm is pivotally connected to a link 680. On the right side of the machine there is a pin 677[a], carried at one end of arm 673 70 and corresponding to pin 677, referred to above. Engaging the pin is a forked lever 678, pivoted at 679[a] and connected at its upper end to a link 680.

Carried by the carriage runway is a cast- 75 ing 681, having a pair of rearwardly projecting arms 682 and 683, upon which are mounted pins 684 and 685. These pins have mounted thereon the ribbon spools 686 and 687. Carried by the lower end of each of 80 these spools is a ratchet plate 688, upon which is mounted a pawl 689, pivoted at 690 and actuated in one direction by a spring 691. These pawls are provided with projections 692, adapted to engage the teeth 85 of a gear 693, formed on a sleeve 694. This sleeve has at its opposite end a similarly geared section 695, which meshes with a gear 696 carried on a pivot pin 697. This gear 696 engages the teeth of a rack 698 and 90 causes reciprocation thereof. Rack 698 has secured substantially centrally thereof a link 699, which is connected to another rack 700. The reciprocation of rack 700 causes the rotation of gear 701, pivoted on the 95 frame. Arm 702 is provided with a slot through which the pivot pin of gear 701 passes. This permits arm 702 to oscillate about its pivot 703. Pivoted on the same pivot as gear 701 is a cam member 704, 100 which engages alternately roller bearings 706 and 707, carried by plate 702. Pivoted on the pin which carries gear 701 is a rocker member provided with a pair of stop shoulders 704[a] (see Fig. 40) and a crank arm 105 carrying a pin 705, which engages in a perforation in the end of the slotted spring actuated pawl 708. It will therefore be seen that, as gear 701 is rotated it causes pawl 708 to be pushed downwardly and rotated 110 about its pivot member 709 until it has passed its center of oscillation. The pin 730 carried by gear 701 alternately engages the stop shoulders 729 on the rocker member and actuates same about its pivot to cause 115 member 708 to be swung upon its center of oscillation. Pin 705 projects backwardly and rests between a pair of lugs on the opposite side of the rocker member from lugs 729. By this connection, member 708 is 120 enabled to give the rocker arm a snap action, as heretofore described. When this happens, the tension of spring 710 causes pawl 708 to move forwardly with a snap action, whereby cam 704 actuates plate 702 125 quickly to cause the longitudinal reciprocation of links 711 and 712. This causes the rocking of levers 713 and 714 about their pivot pins 715 and 716, whereby arms 717 and 718 are respectively caused, one to en- 130

gage and the other to disengage ratchets 688. These arms carry fingers 719 and 720, which engage corresponding fingers 721 and 722 on pawls 723 and 724, pivoted respectively at 725 and 726 on bell cranks 727 which in turn are pivoted on pins 684 and 685, carrying the spools, and actuated by links 680 connected to the bell cranks at 728. It will therefore be seen that as bell crank 727 is actuated about its pivot, either pawl 723 or 724, provided with a bent over or hook portion 729, will engage a ratchet 688 and cause the same to be rotated about its pivot. Since only one of the hooks 729 can engage a ratchet 688 at one time, it is evident that only one of these ratchets can be rotated thereby, and therefore that only one of the spools 686 can be actuated at a time, the ratchets being rigidly connected to a flange of the spools.

Each of the spools is provided with a member 731 projecting into a position where it is adapted to engage an end of pawl 689 so as to release projection 692 from gear 693. This is caused when the ribbon is tensioned about the spool as it is being wound thereon.

Supporting pins 684 and 685 are a pair of plates 732, capable of vertical oscillatory movement, which carry a pair of rollers 733, adapted to hold the ribbon close to the platen. The mechanism just described is that which is concerned in the horizontal motion of the ribbon from one spool to the other, and provides also for the reversal of the direction of the ribbon. The mechanism now to be described is that which provides for the raising and lowering of the ribbon, whereby the entire width thereof may be utilized in the printing operations.

In connection with this description, reference should be had to Figs. 21, 37, and 39. Connected to arm 530 by a pin 734 is a link 735, having a forked end which engages a pin 736 on a ratchet wheel 737 mounted on the carriage runway. In the position shown in Fig. 21, arm 530 is in its upper position and pin 736 cannot cause reciprocation thereof, but when this arm is in its lower or normal position, the rotation of ratchet 737 will cause pin 736 to engage in the closed end of the fork of member 735 and cause the lifting of arm 530. This arm being secured to shaft 529 causes the oscillation of this shaft in its bearings and thereby causes arms 738 to lift plates 732 carrying with them the ribbon spools and associated mechanism. By reason of this, the ribbon is caused to be raised relatively to the platen and type, and therefore the printing takes place at a different position with respect to the width of the ribbon.

Carried by shaft 672 is an arm upon which is mounted a pawl 739. As this shaft is oscillated, the pawl is caused to engage ratchet 737 and move the same forwardly about its pivot to cause the actuation of shaft 529, as stated above. Reverse motion on this ratchet is prevented by means of a spring actuated pawl 740. Pawls 739 and 740 are connected by means of a spring 741 tending to draw them toward each other.

In the printing of an overdraft, the ribbon is raised to its extreme elevated position in order to have the amount printed in a distinctive color. This is accomplished by cam 528 engaging roller 532 on arm 530 and raising the same, as heretofore set forth.

As will be seen in Fig. 37, the spools are held in place by fork-shaped clips 742 engaging the upper end of sleeves 694. These fork-shaped springs 742 may be removed and the ribbon spools readily taken off for replacement of a new ribbon.

Carriage mechanism.

(See Figs. 1, 2, 37, 38, 39, 41, 49 and 52.)

In order to feed the paper, mechanism is provided for actuating the platen, and this will now be described, with reference to Figs. 37, 39, 41, 42, and 43. Pivoted in the carriage and supporting frame is a shaft 743, carrying an arm 744 provided with a roller bearing 745, adapted to ride on the cams 670 and oscillated thereby as arm 668 is oscillated, as heretofore set forth. Secured to shaft 743 is an arm 746, one end of which is adapted to engage a shaft 747 (Fig. 37) supported by a pair of arms 748 secured to shaft 749. This shaft carries an arm 752, which has secured thereto a spring actuated pawl 750, the end of which engages a ratchet 751, loosely mounted on shaft 751ª carrying the platen (Fig. 42). A stop and positioning member 753 is provided to hold the platen in position so that the printing will be in proper alinement. The end of arm 752 is provided with a lateral extension 754, whereby the same may be manually actuated. Integral with arm 752 is a stop finger 755, adapted to engage an oscillatory stop member 756 carried by a pin 756ª, whereby to regulate the number of spaces which the platen will be moved forwardly by the actuation of the mechanism just described. On the outer end of this pin 756ª is a pointer 756ᵇ to indicate the number of spaces which the platen will be moved forwardly by the actuation of the above described mechanism. Arm 752 is provided with a perforation 757 for the reception of a pin to which may be attached a spring 758 adapted to pull arm 752 into retracted position (Figs. 41 and 43).

Mounted on the projecting end of shaft 751ª at the right side of the machine is a reciprocatory sleeve 759 (Fig. 42) which serves as a clutch member whereby to clutch the shaft 751ª and the ratchet 751 together. The sleeve 759 is provided in its interior

with a space in which is mounted a spring 760 to cause the sleeve to move inwardly whereby its inwardly bevelled flange 761 engages a corresponding bevel on ratchet 751. The sleeve is provided with a flange 762 adapted to be engaged by the fingers of the operator so that it may be pulled outwardly at the time that the platen is being rolled forward or backward. If it is desired to move the paper forwardly or backwardly a part of a space so as to enable printing in proper alinement, it is only necessary to pull outwardly on flange 762 and rotate the handle 763 and then permit sleeve 759 again to engage the bevelled projection on ratchet 751.

The pin 754 passing through shaft 751ª and sleeve 765 causes the latter to rotate with the shaft when handle 763 is turned. Sleeve 765 is provided on one side, as shown at 766, with a slot in which engages a headed pin 767, extending into sleeve 759. This prevents relative rotation of the sleeves 759 and 765, when the handle is turned, and permits the longitudinal sliding of sleeve 759 with respect to sleeve 765.

Secured to a shaft 768 (Figs. 37 and 41) are a pair of plates 769 and 770 (Figs. 39, 41, 42) perforated to receive sleeve 771, surrounding shaft 751ª. It will therefore be seen that when finger piece 772 on plate 769 or plate 770 is pushed backwardly, the platen will be raised so as to render the printing on the paper visible, as shown in Figs. 44 and 45. Also carried by shaft 768 is a finger 773, which is engaged by a roller bearing 774 mounted on a spring actuated finger piece 775. As the platen is raised, finger 773 is moved upwardly about the shaft upon which it is carried and roller bearing 774 rides under this finger and holds the platen in elevated position. If desired finger piece 775 pivoted on shaft 779 may be depressed to release finger 773 and with it the platen so that the latter will return to normal position, shown in Fig. 41.

As will be seen from Figs. 38 and 41, the downward movement of the platen is limited by a screw 776, threaded into casting 777 and held in adjusted position by a set nut 778. By loosening nut 778 screw 776 may be adjusted so as to secure a proper positioning of the platen when in lowered position.

Lever 775 is pivoted upon pin 779 (Figs. 41 and 42) which is surrounded by a coil spring 780, shown in dotted lines in Fig. 42, the purpose of this spring being to furnish tension for lever 775 to cause the same to follow finger 773 in its forward motion. One end of spring 780 engages a tension adjusting means 781, surrounding pin 779 and by reason of this adjusting means the tension of spring 780 may be adjusted to any desired amount, or may be varied if rendered necessary because of the weakening of the spring.

Referring now to Figs. 38, 41, 42, 44, 45, 46 and 47, the connection and operation of controls 769 and 770 will be seen. These members are secured to shaft 768, pivoted in a pair of supporting arms 781, secured to shaft 782. It will be seen that as arms 769 and 770 are rotated about their pivot, they raise the shaft of the platen and thereby cause same to be elevated so that the printing on the paper may be seen and also as an aid in inserting the paper. These plates 769 and 770 are provided on one side with shoulders 783 adapted to engage an abutment whereby to limit the oscillation of the plates in one direction. These plates are also provided with projections 784 carrying a shaft 629 to which is secured a curved plate 785 adapted to serve as a guide in the insertion of paper around the platen. As previously stated, the lifting of shaft 629 releases a lever 628 (Fig. 52) whereby a locking means is permitted to lock the hammer mechanism to prevent the same from being actuated while the platen is in elevated position.

For the insertion of paper, the platen will normally be raised to the position shown in Fig. 46, in which position it will be held by roller bearing 774 on lever 775. The paper will now be fed over a guide plate 786 (see Figs. 37, 41, 49) and below the platen, passing in between the platen and roll 787, carried on a shaft pivoted in levers 788 under spring tension due to springs 789. The paper will now pass between plate 785 and the platen and will come into view about a plate 790 at the point indicated by the arrow in Fig. 44. By now pulling forwardly on lever 791, a roller bearing 792 is caused to press downwardly on a cam 793 upon the support for plate 790, thereby forcing this plate to raise to the position shown in Fig. 46. Continuing the feeding of the paper will cause the same to be fed between the platen and roll 794 mounted upon a shaft pivoted in the end of a pair of supports 795 normally spring tensioned toward the platen by springs 796. This paper can now be allowed to come out above plate 797 (Figs. 41 and 44) or beneath this plate, as shown in Figs. 44 and 47. Connected with this plate is a cutting edge 798 (Figs. 2, 37 and 41) to serve in tearing the paper when the same is fed from a roll and it is desired to separate a part already used. The upper dotted line position shown in Fig. 44 is that ordinarily used when feeding sheets of paper through the machine.

When it is desired to place the paper for filling in or completing a line partly written, the paper may be properly lined up by pulling lever 791 to the position shown in

Fig. 44 so that plate 790 is in the position shown in Figs. 44 and 45 with the edge thereof just below the printing line. In this position, pin 799 rests in a notch in the cam face 800 of lever 801. This lever has projecting from one side thereof a finger piece 802, whereby the same may be operated, and has secured to the opposite side thereof a roller bearing 803 adapted to cooperate with a cam member 804 projecting from member 781. As the platen is lowered about its pivot 768, roller bearing 803 engages cam member 804 and rocks lever 801 about its pivot 805 to release pin 799 from the notch in cam face 800, therefore permitting lever 791 to assume its normal position, roller bearing 792 then being out of contact with cam 793. This permits plate 790 under tension of spring 789 to drop until stop member 806 strikes pin 807. Secured to the end of shaft 808 upon which lever 791 rocks is a cam member 809 (see Fig. 41) which engages a finger 810 when lever 791 is pulled forwardly thereby pushing finger 810 backwardly from shaft 808. When this happens roller bearing 753, which normally engages the ratchet 751 and is carried by a projection of plate 811 of which finger 810 forms a part, is raised from the ratchet and permits the platen to be turned over free from the normal retarding influence of the roller bearing and ratchet. The arm upon which roller bearing 753 is mounted is continued beyond this bearing and is provided with an attachment for a spring adapted to bias the roller bearing toward the ratchet.

When lever 791 is rocked backwardly from normal position (see Fig. 47) pin 812 engages a finger 813 projecting downwardly and backwardly from arm 795 and rocks this arm about its pivot 808 to raise roller 794 from the platen, whereby to release the paper. At the same time, a pin 814 on lever 791 engages an end 815 of lever 788 and rocks the same about its pivot 816 to release the roller 787 from the paper on the lower side of the platen.

Pivoted on the outer end of shaft 782 is a lever 817, provided with a sleeve 818 to give the same a firm bearing. (Figs. 41 and 42.) This lever has at one end a pin 819 to which is pivoted a link 820, the opposite end of which is pivoted at 821 to a rocker member 822 secured to shaft 823. Also secured to shaft 823 is a locking member 824 (see Figs. 41, 80 and 81), having a shoulder 825 adapted to be engaged by a bail 826ª, whose ends are turned over to form a pair of levers 826. This bail is adapted to rock member 824 about its pivot (Figs. 1, 32, 37, 38, 41 and 80). Locking member 824 has thereon a projection 827 adapted to engage notches in any one of a plurality of feathers 828, carried by a shaft 829, as best shown in Figs. 37 and 80. The free end of lever 826 carries a rod 830 which rests in a double cam slot 831 in one end of a reciprocable plate 832. This plate is provided with a slot 833, through which passes the bolt 834, which serves to secure the plate to the base of the machine and guide it in its reciprocation. The forward end of this plate is provided with a perforation 835, which receives the end 836 of a lever 837, pivoted at 838 and having its opposite end fork-shaped, as at 839, to engage a pin 840, carried by the carriage clutch control CC. It will therefore be obvious that when this clutch control CC is rocked about its pivot 841, plate 832 will be reciprocated and one or the other end of slot 831 may be caused to engage rod 830, whereby to raise finger 827 of locking member 824 out of a position in which it engages the notches of feathers 828. It should perhaps be noted in this connection that clutch control CC is provided with a plurality of notches in one part of its periphery adapted to be engaged by a pin 842 to hold the clutch control in adjusted position. This pin 842 is carried by a plate 843 biased upwardly by a spring connected to pin 841.

The carriage runway casting 844 has secured to the ends thereof a pair of castings 845 (see Figs. 39 and 42) through which extends the shaft 829. This shaft is provided near one end with a notched stop member 846 adapted to be engaged by a stop pawl 847, which is spring tensioned toward the shaft to hold the same in any adjusted position in which the pawl engages one of the notches in the plate 846. Shaft 829 is provided at one end with a milled head whereby it may be rotated to place any one of feathers 828 in position for the notches thereof to be engaged by projection 827 of locking member 824. As shown in Fig. 39, castings 845 are continued downwardly and support the shaft upon which member 826 is pivoted.

For details of the paper carrier and support, reference may be had to Figs. 1, 2, 37, 38, 41, 48 and 49. Secured to the outer face of each carriage casting by means of screws 850 is a plate 849, forming a supporting means for several parts of the carriage. Secured in plates 849 are pins 851 and 852, adapted to receive notches in the end plates 854 of the roll holder mechanism 853 whereby to support the same. Upon plates 854 are pivoted at 855 hook members 856 adapted to be pressed into engagement with pins 852 by means of springs 857, whereby to lock the roll holder to the carriage. (Figs. 1 and 38.) The paper roll 858 is supported on pins 859, carried by plates 860, which are adjustable longitudinally of shaft 861. The lower end of plates 860 is provided with a notch (Fig. 37) to engage a shaft 862 to permit longitudinal shifting of the plates but to prevent oscillation thereof about shaft

861. Mounted in the upper ends of plates 849 is a shaft 863, which serves as a support for the reading support 864, carrying edge guides 865, secured to plate 864 by means of bolts and wing nuts 866 (Figs. 48 and 49) the bolts sliding in slots 867 in plate 864. Between plate 864 and guides 865 is a layer of soft material such as felt 868, to prevent the scratching of one part by the other.

The end plates supporting plate 864 are provided with notches adapted to engage shafts 782 and 863, the latter of these being engaged by a spring pressed hook 869 pivoted at 870, whereby the paper supporting table 864 is locked to the machine.

Carriage runway 844 is grooved in two opposite edges and the faces 871 of these grooves provide faces against which ride rollers enclosed in cages to serve as supporting and guiding means for the carriage in its reciprocation on the runway. This carriage has a main casting 872 (Fig. 37) to which the other parts of the carriage are secured and by which they are supported on the runway. The bearings each comprise a substantially rectangular cage having in opposite sides perforations for the reception of the ends of a spindle forming the axle of a roller the edge of which projects through opposite openings at right angles to the perforations. Each cage is also provided with other perforations and openings so arranged that another roller may be contained therein with its bearing surface at right angle to the bearing surface of the first mentioned roller, the structure being shown most clearly in Figs. 37 and 41.

Shifting mechanism for carriage.

Secured in the member 832 is a pin 873 (Figs. 25 and 37) which projects through a slot 874 in a lever 875 pivoted at 876 and has at its opposite end a cam face 877 divided into two parts by a notch 878. This cam face is adapted to be engaged by roller bearings 879 carried by one end of each of levers 880 and 881, drawn toward each other by a spring 882. It will be seen from the above that when lever 875 is rocked about its pivot, one or the other of roller bearings 879 will drop into notch 878, thereby permitting either lever 880 or 881 to be pulled toward the other whereby the mechanism connected therewith is caused to be actuated. The pins mounted in the ends of levers 880 and 881 (see Fig. 32) engage in grooves between flanges on sleeves 883 and 884. This causes the sleeves to slide longitudinally on shaft 885 and thus causes the engagement of either disk 886 or 887 with a disk 888, secured to shaft 885. Slidably mounted on these sleeves are a pair of gear wheels 889 and 890, which are driven from shaft 891. Hence when one of disks 886 and 887 is caused to engage disk 888 and shaft 891 is driven, shaft 885 will thereby be caused to rotate and carry with it gear 892 in mesh with rack 893 secured to the carriage. By reason of the fact that a gear 894 secured to shaft 891 (Figs. 32 and 37) is in direct engagement with gear 889 and a gear 895 also secured to shaft 891 in indirect engagement with gear 890, through the intermediary of a gear 896, shaft 885 will be caused to rotate in one or the other direction depending upon which of disks 886 or 887 is in engagement with disk 888.

By referring to Figs. 25, 31, 32, 33, and 37, it will be seen that shaft 891 is continued forwardly and is provided upon its forward end with a bevelled gear 897, which meshes with a bevelled gear 898 upon a shaft 899. Secured to left end of this shaft is a gear 900, meshed with the gear 901 loosely mounted on shaft 585, and secured to gear 901 is a plate 903, having a stop member 904, normally engaged by one of the levers 905 and 906 pivoted at 902 and 902[a]. Carried between gear 901 and plate 903 is a pawl 907 corresponding to pawl 587 and normally spring pressed into engagement with a ratchet 908 keyed to shaft 585, but which is held out of engagement therewith when either stop member 905 and 906 comes into engagement with the projecting end of this pawl. It will therefore be seen that since shaft 585 is constantly rotating when the motor is running, gear 901 will be driven whenever pawl 907 is released by the disengagement of stop lever 905 or 906 therefrom. This will cause the driving of gear 900, shafts 899 and 891 to gears 889 and 890, and the connected disks 886 and 887. This will drive disk 888, shaft 885, gear 892, and rack 893, as heretofore explained in the event that either disk 886 or 887 is in engagement with 888. It should be noted in this connection that casing 8, inclosing gears 897 and 898, and shaft 899, is normally sufficiently filled with lubricating material to keep all operating parts contained therein in properly lubricated condition. The shafts passing through the walls of casing 8 are properly bushed to prevent an undue amount of grease from passing outwardly through the perforations in the walls of the casing. If it is desired to have the mechanism just described constantly driven, all that is necessary is to connect levers 905 and 906 by a link 909, shown in dotted lines in Fig. 32. This is a detachable link, the ends of which are bent over to be slipped through perforations in the levers so that the same may be attached and detached at will. Levers 905 and 906 are normally biased toward each other by means of a spring 905[a] and have their motion in one direction limited by stop pins 905[b] and 905[c].

Debit-credit carriage control.

Reference will now be made to Figs. 25, 31, 32, 33 and 34, in which Figs. 25 and 32 show the debit credit control mechanism in normal position. In this position, actuation of the ASC lever does not cause any actuation of the carriage driven mechanism. When it is desired to place the added items at one side of the sheet and the subtracted items at the other side, as in preparing bank statements, for example, the control lever DC is shifted to the right or left of normal position shown in Figs. 2ª and 25. In Fig. 34 the lever is shown in solid lines as shifted to the left and in dotted lines as shifted to the right. When this control is shifted to the left, as shown in Fig. 34, the subtracted items will be placed at the left side of the paper and the added items at the right. Assuming the DC lever set as shown in Fig. 34 and the CC lever pulled forwardly to the end of the slot marked "Right", if the ASC lever is now pulled forwardly to subtracting position, the carriage will be caused to shift to the right, thereby causing the placing of the paper for the printing of subtracted items at the left of the paper. After this has happened and before the items are entered, it is advisable though not necessary to set the CC lever at "Left" so that when the ASC lever is pushed upwardly to adding position, the carriage will be shifted to the left for the entry of added items on the right side of the paper. It will of course be understood that in either of these positions as many items as desired may be entered before the carriage is shifted and also that the carriage will not be shifted to the right with the ASC lever in adding position nor to the left with the ASC lever in subtracting position unless the DC control is shifted to the dotted line position shown in Fig. 34 neither will there be any shifting of the carriage if either the DC or the CC control is in central position. Normally there is no change in the DC control since it is customarily desired to have the subtracted items at the left and the added items at the right.

Extending downwardly from member 125 and below its pivot 126 (see Figs. 25 and 33) is an arm 910, offset laterally as shown at 911 and extending downwardly as shown at 912. At its lower end, this arm is pivoted to a link 913, which is connected at its forward end to a pair of members 914 upon an oscillatory member 915 (Fig. 34) having throughout the greater portion of its length an S-shaped slot 916. Extending through this slot is a headed pivot pin 917 connected to the DC lever and adapted with the shifting of this lever to slide in the slot 916. Secured to plate 915 is a plate 918, carrying the securing means whereby the mechanism being described is secured to the base plate 3 of the machine. It will be seen from the above that when the ASC lever remains in any fixed position, the member 915 cannot be caused to oscillate about its pivot 922 and that therefore when the DC lever is moved to the right or left, its rearwardly extending portion 919 will be moved longitudinally carrying with it link 920, pivotally connected to a pair of bars 921, adapted to oscillate levers 905 and 906 about their pivots, as will be obvious from Fig. 33. When the pin 917 on the DC lever is at either end of slot 916 and the ASC lever is actuated, member 915 will be caused to move about its pivot 922 by the reciprocation of link 913, but if the DC lever is in its central or normal position, as shown in Fig. 2ª no reciprocation of parts 919 and 920 will be caused by the actuation of the ASC lever.

Driving mechanism.

In connection with the description of the driving mechanism, reference should be made to Figs. 1, 4, 29, 30, and 31. By referring to Fig. 4, it will be seen that when the touch bar is pressed downwardly, bars 138 and 138ª rock levers 136 and 139 about their pivots 130 and 140, reciprocating link 137 rearwardly as heretofore explained. Pivotally connecting link 137 and lever 139 is a pin 923, which engages one end 924 of a lever 925, pivoted at 926 whose other end is provided with a lug 927, which, being depressed, engages and forces downwardly arm 928 of lever 929, pivoted at 930. Normally stop member 578 holds pin 579 out of the path of arm 928 and stop 580 out of the path of projection 582. If, however, the sub-minus total control has been pulled, pin 579 is released, as heretofore stated (see "Sub minus total control mechanism") and rises to the position shown in full lines in Fig. 35. Now as arm 928 is moved downwardly it engages pin 579, forcing it downwardly and rocking stop member 580 about its pivot to release disk 584. Depressing arm 928 carries rearwardly the stop member 589, heretofore referred to, thereby releasing disk 584 and its connected pawl 587. As previously stated, this operatively connects shaft 585 and disk 584 so that the latter is driven by the rotation of the former. Carried by disk 584 is a roller bearing 931, which, during the course of its rotation, engages finger 932 of lever 933, pivoted at 934, whose opposite end is pivotally connected at 935 to pawl 241, which, as previously explained, engages pin 243, thereby rocking shaft 117 about its pivot 118 to cause the clearing of the keyboard, as heretofore set forth. As this roller bearing travels further, it engages stop member 936, moving it forward-

ly until the shoulder of the stop member has been passed, when the roller bearing will engage in a notch in the end of this stop member, thereby preventing backward rotation of the mechanism. Members 933 and 936 are actuated toward each other by means of a spring 938, which tends to hold them in their normal positions. It will be seen from Fig. 4 that stop member 589 is held in normal stopping position by means of a spring 939. Coiled about the pivot 926 is a spring 940 having its ends engaging respectively a pin 941 on member 925 and an end 942 of lever 943, whose opposite end carries a roller bearing 944 pressing upwardly against pawl 241 to hold it in engagement with pin 243. Member 943 is limited in its upward motion by a stop finger 945, which engages base plate 3 of the machine. It should be mentioned in this connection that as disk 584 rotates about its pivot 585, it reciprocates link 191, which is pivotally connected at one end to disk 584 and at its opposite end to arm 209ª of the segment 192, as heretofore set forth.

From Figs. 26 and 30, it will be seen that when finger 924 is forced rearwardly, it carries with it link 946, provided at one end with a hook 947, which engages a pin 948 carried by lever 925. This reciprocation of link 946 rocks member 949 about its pivot 950 and causes lug 951 to engage lever 952, rocking same about its pivot 953 against the tension of spring 954, and causes its end to engage arm 955 of a lever pivoted on pin 950, whereby the same is rocked about this pivot. As will be seen by comparing Figs. 26 and 30, the rocking of this lever causes links 956 and 957 to be raised, thereby actuating levers 958 and 959 about their respective pivots. It will be seen that lever 959 is provided with a pin 960 which engages a slot in the end of link 957 and that its hook 961 is caused to be disengaged from pin 962 when the lever is rocked about its pivot 959ª. Releasing this pin, which is connected to the operating bar 963 for the switch by an arm 964, permits the switch to be actuated, as will be explained.

As member 958 is rocked about its pivot, link 965, connected to said member by a pin 966, is reciprocated and carries with it switch operating bar 967 by reason of the connecting member 968, which has a pin and slot connection with link 965. Bars 963 and 967 have turned over ends 969 and 970 (Fig. 29) provided with adjustable means 971 which may be adjusted to engage the end of the push buttons 972 of the switch E. It will of course be understood that when one of these push buttons is forced inwardly, the other one will be forced outwardly, as is customary in such switches.

When link 956 is pulled upwardly, as heretofore explained, it carries with it pin 973 secured to member 958 and causes the rocking thereof about its pivot. This action is also assisted by a helical spring 974, having one end secured to a spool 975 and its opposite end secured to a pin 976, carried by member 958 (see Figs. 27 and 28). Inside of spool 975 is a spacing sleeve 977, and inside of this is another sleeve 978, which is secured to the spool by a pin 979 passing through these three members. Sleeve 978 is secured by means of the pins 980 to a member 981, pivoted on the same shaft 982 as member 958. It will therefore be seen that such a tension may be placed on spring 974 as to cause the projecting ends 983 and 984 of members 958 and 981 to approach each other. It will be seen from the above that when plate 584, carrying roller bearing 931, rotates about its pivot, this roller bearing (see Figs. 26 and 30) will engage end 984 of member 981 and cause the same to be rocked downwardly about its pivot. This will force link 985, pivotally connected at 986 to member 981, to be reciprocated forwardly, thereby carrying pivot 959ª and with it link 959 into such a position that hook 961 may engage pin 962, when lever 959 is permitted to return to normal position. Link 985 is provided in its forward end with a slot 987 to permit the oscillation of pin 962 independently of the link. The purpose of this pin is merely to serve as a guiding means for link 985 in its reciprocation. It will be noted that lever 959 is provided with a projection 988 to which is connected a spring 989, adapted to rock said lever about its pivot 959ª, when it is free to do so by reason of the position of link 957.

Member 981 is provided on its forward side with a finger 990, adapted to abut against a stop member 991 to limit the rocking motion of said plate 981 in one direction about its pivot. Also projecting from plate 981 is an arm 992, carrying pivot pin 953 upon which member 952 is pivoted. Also carried by this arm 992 is pivot pin 993, upon which is mounted a pawl 994 adapted to engage the teeth of a ratchet 995. This will prevent forward motion of arm 992 and consequently place 981, under the influence of spring 974 at a greater rate than that at which ratchet 995 is driven by shaft 982 to which it is secured. Pawl 994 is pushed toward ratchet 995 by a spring 996 and rides over the teeth thereof when arm 992 is oscillated backwardly.

Ratchet 995 and shaft 982 are driven in the following manner: When stop member 589 releases pawl 587 and disk 584, the same are carried forward with shaft 585 as heretofore indicated. Carried by worm wheel M^3 inside of the casing 8 is a pin 997, which during the rotation of the worm wheel

comes into engagement with the lever 998, forcing same rearwardly about its pivot shaft 999 to which is secured an arm 1000, carrying a roller bearing 1001. As this roller bearing is actuated forwardly, it engages the end of a reciprocatory shaft 1002 carrying at its forward end a pawl 1003 biased toward a ratchet wheel 1004 by a spring 1005. Shaft 1002 is normally held in a rearward position by a spring 1006, abutting against a collar on the shaft. It will thus be seen that as shaft 1002 is pushed forwardly, the pawl engages the teeth of ratchet wheel 1004 and rotates same about its shaft 1007 to which it is secured thereby causing actuation of worm 1008, carried by the shaft. The actuation of this worm causes the driving of gear 1009, secured to shaft 982 and through this the driving of ratchet 995, as set forth above. It will be noted that casting 7 supporting the timing mechanism T may be bodily removed from the base plate 3, carrying with it the timing mechanism, and that the machine will then be operative in the usual manner without the timing feature.

As roller bearing 931, carried by plate 584 is carried about shaft 585, it strikes a cam face on the end 983 of plate 958 and forces the same upwardly into normal position, shown in Fig. 26, thus restoring link 965 to its forward position, so that there will be no obstruction to the forward motion of the pin carried by connecting arm 968 when the timing mechanism reaches the point of throwing off the switch. This rotation of member 958 about its pivot causes link 956 to be pulled downwardly, thus forcing link 957 downwardly so that lever 959 may have its hook 961 raised under the influence of spring 989. This sets the hook in front of pin 962 so that when the plate 981 is rotated in a counterclockwise direction, the pulling backwardly of link 985 will cause bar 963 also to be pulled backwardly, thus throwing off the switch.

Modifications.

In the modification shown in Figs. 84 and 85, a different form of interlock for the ASC, TC, and STC levers is provided. In this form, when either the total or sub-total control is pulled, link 262 actuates the ASC lever, as in the form already described. This action is assisted by the engagement of pin 276 with link 277, which rocks shaft 280 to cause the ASC lever to be rocked on its pivot through the intermediary of link 1015 and rocker member 1013. Member 129 is provided with a hook 1010, which engages pin 311 on the total control and locks the same in forward position. It is now impossible to return the total control by itself, but if the ASC lever is pushed to adding position, cam 127, riding over roller bearing 128, mounted on lever 129, rocks the same about its pivot 130 and releases hook 1010 from pin 311. At the same time, pin 1011, engaging finger 1012, rocks arm 1013 about its pivot 234, carrying pin 1014, connected to link 1015, forwardly. This pulls arm 1016, pivotally connected to link 1015 forwardly about its pivot 280, thus pushing link 277 upwardly and rocking the TC and STC levers about their pivot 260.

When the non-add control is pulled forwardly about its pivot, the pivot member 244 is moved rearwardly and with it link 246. This pulls lever 248 rearwardly about its pivot so that finger 249 locks the ASC lever in adding position and causes cam member 250 to force downwardly locking finger 1017 on member 252. When the point of cam 250 passes the point of member 1017, the latter is permitted to again rise and the engagement of these two members then locks member 248 so that the release of the interlock is prevented until the machine has been actuated. When the touch bar is struck and the machine actuated, locking member 250 will be released from 1017 provided the repeat control has not been pulled forwardly. When this interlock is released, the non-add control will be returned to normal position, owing to member 253 being actuated about its pivot 180 by a spring surrounding said pivot, as shown in the dotted lines in Fig. 84. The connection of member 253 with the non-add control by means of pin 244 is shown in Fig. 84.

The release of the interlock between members 250 and 1017 is caused by member 117 engaging a cam face 1018 on a rearwardly projecting arm of member 252. It should be noted that finger 1017 has its end bent over to form a sufficient surface for engagement of member 250 to make it certain that these parts will inter-engage.

In the form shown in Figs. 84 and 85, arm 256, carrying hook 257, and the arm of lever 211, carrying pin 258, are dispensed with, as the same are now unnecessary.

Carried by link 226 is a hook member 1019, which is engaged by a pin 1020 on the total control when the same is pulled forwardly. The engagement of this pin with the hook member causes link 226 to be actuated forwardly in the event that the repeat control has previously been pulled, and causes the return thereof to normal position.

The construction shown in Fig. 60 may be simplified, as shown in Fig. 86, by the omission of members 190 and 317, together with connecting sleeve 315 and pin 188 on member 125.

The construction of the type magazine may be modified as shown in Figs. 87 and

88, by omitting the fingers shown in Fig. 50 between the springs and by adding a pair of springs 1021 connected at one end to a fixed portion of the type magazine and at their opposite end to the ends of a spring wire 1022, which engages a shoulder on each of the type bars, as shown best in Fig. 88. This will cause the retraction of any type bar which has been forced outwardly by a hammer blow, and does away with the necessity for a large number of springs. This also simplifies the construction of the type bar since the hook necessary in the construction shown in Fig. 50 may be dispensed with. The detail construction of the type bars may be seen by referring to Figs. 51, 54 and 89.

In order to insure perfect operation of the carriage stop members utilized in stopping the carriage when the same is actuated transversely of the machine, locking member 824 has a portion of the locking end 827 thereof cut away, as shown in Fig. 80, and in this cut-away portion is mounted a pivoted locking element 1023, formed of a pair of cross-arms of equal length but extending unequal distances from the point of union, as shown most clearly in Figs. 81 and 82. This locking member is pivoted at 1024 and is biased to the position of this locking member as shown in Fig. 83, in which one of the arms extends downwardly through a slot in one of the feathers 828, while the other arm rests on the top of this feather. When rod 830 is depressed, bail 826ᵃ rises, engaging shoulder 825 and thereby lifting the locking member 1023 out of the slot, whereupon the springs 1025 rotate this locking member substantially into the position shown in Fig. 81. When the carriage control lever is operated to either extreme position or to a central position, bail 826ᵃ permits member 824 to descend until the cross arms rest upon the top of the feather, thus holding the locking end 827 of member 824 above the plane of the feather. The force tending to cause rotation of member 824 about shaft 823 is sufficient so that when the carriage is caused to move transversely of the machine, one end of one of the arms 1023 will be caused to drop into a notch in the feather as the same reaches the end of the arm. The motion of the carriage will continue until projection 827 engages the notch, when further motion of the carriage is prevented.

In Figs. 76–79 inclusive is shown a mechanism for increasing the speed of transfer and simplifying the driving mechanism before the sector drive shaft and the sectors. In this construction, instead of having sectors 355 friction-driven from shaft 176, they are loosely mounted upon this shaft and are held in fixed relation with respect to sectors 356 by member 354, as heretofore explained, but are biased in one direction or the other with respect to said sector by means of springs 1026 and 1027. Rigidly secured to shaft 193 is a pair of crank arms 1030 pivotally connected to a pair of links 1031. The opposite end of these links is connected to a pair of members 1032 loosely mounted on shaft 176. Each of members 1032 carries a pin 1033, which projects through a slot 1034 in an end of arm 1029 is free to move downwardly under the influence of springs 1026 and 1027, mounted respectively on the sector arm 59 and an arm 1035 of sector 355. When the lower arm of spring 1027 strikes the bottom of hook 1036 on the arm 1035, this spring will cease to have any effect upon bail 1028, but link 1031 continues to force arms 1029 and bail 1028 downwardly to the limiting position as shown in Fig. 77. Carried on arms 1035 are roller bearings 1037, which are engaged by springs 1026 when bail 1028 has lowered to a point where it no longer keeps the springs out of contact with the roller bearing. When this spring engages the roller bearing and the bail moves away therefrom, if stop finger 354 be removed from notch 351, sector 355 will be moved forwardly with respect to sector 356 by the tension of spring 1026 against the roller bearing. This is the action during a subtracting operation and it will be seen that because of this structure sector 355 will be snapped forwardly quickly under the influence of spring 1026 mounted upon pin 384 and having an end secured to sector arm 59 by a pin 1026ᵃ, since the sector 355 is loosely mounted upon shaft 176.

In Fig. 76, the parts are shown in normal position with the machine idle. If now a transfer is to be made in an adding operation, finger 347 is released and spring 352 causes the lowering of member 350, thereby releasing stop member 354. When this occurs, spring 1027, secured at 1038 and having one end secured to pin 1039 and its opposite end resting on roller bearing 1040, causes arm 1035 and with it sector 355 to be moved upwardly about shaft 176. It will therefore be seen that the transfer will be made to dial wheels 336 by sectors 355 instantly upon the release of stop member 354 from notch 351.

Improving dial wheel visibility.

In order to render the dial wheels visible at all times, the face plate 1041 of the machine is provided with a pair of slots 1042 and 1043, as seen best in Figs. 2 and 50. Beneath these slots is secured to each of the dial wheel arms 491 and 161, a shield 1044 or 1045, respectively. These plates cover the gear teeth of the dial wheels and all but one numeral thereof, it being provided with a notch 1046 as shown in Fig. 2. It will be noted that plate 1041 is secured to the frame castings and remains stationary while plates 1044 and 1045, being secured to movable

arms 491 and 161, rise and fall therewith during the operation of the machine.

Locks.

At the left side of the machine (see Fig. 2) is a lock L secured to the carriage runway casting. The plunger 1047 of this lock passes through a perforation in the casing 6 and frame casting 5, thereby preventing the removal of the casting and carriage from the machine. This prevents unauthorized meddling with the mechanism of the inside of the machine.

Extending downwardly from base plate 3 of the machine (see Fig. 31) is a member carrying a lock L^1 having a plunger 1048, which extends through a perforation in 584 to prevent the actuation of pawl 587 and thereby prevent the machine from being turned over by touching off the touch bar TB.

Having described my invention, I claim:

1. In a machine of the character described, a set of dial wheels, a set of overdraft or net credit dial wheels, a set of sectors for operating the first set of dial wheels, a set of sectors for operating the second set of dial wheels, connecting means between the sectors for operating a sector of one set by a sector of the other set, and means for releasing the connection so that one sector may move relatively to its connected sector.

2. In a machine of the character described, a set of dial wheels, a set of overdraft or net credit dial wheels, means for operating the second set in conjunction with the first set, oscillatory means for limiting the amount of rotation of the first set of dial wheels, means for indicating when a subtracting operation causes the accumulated total to become negative, and means for determining the amount of a negative total, including an oscillatory feather carrying shaft whereby to change the limit of rotation of the overdraft dial wheels when determining the amount of a negative total.

3. In a machine of the character described, a set of dial wheels, a set of overdraft or net credit dial wheels, means for operating the second set in conjunction with the first set, oscillatory means for limiting the amount of rotation of the first set of dial wheels, means for indicating when a subtracting operation causes the accumulated total to pass zero, and means for determining the amount by which zero has been passed, including an oscillatory feather carrying shaft whereby to permit the overdraft or net credit dial wheels to rotate one more space than the first-named dial wheels.

4. In a machine of the character described, a set of overdraft or net credit dial wheels, means to rotate said dial wheels to determine the amount of the overdraft or net credit, means to limit the sphere of action of said last-named means, including a rotatably mounted feather carrying shaft.

5. In a machine of the character described, a set of overdraft or net credit dial wheels, means to rotate said dial wheels to determine the amount of an overdraft or net credit, means to limit the sphere of action of said last-named means, including a rotatably mounted feather-carrying shaft, the rotation of said feather-carrying shaft removing the feather from the path of said dial wheel rotating means, whereby the overdraft or net credit dial wheels are permitted to make a full revolution during the operation of determining a negative total.

6. In a machine of the character described, a set of overdraft or net credit dial wheels, means to rotate said dial wheels to determine the amount of an overdraft or net credit, means to limit the sphere of action of said last-named means, including a rotatably mounted feather carrying shaft, and means for restoring the shaft to normal position.

7. In a machine of the character described, a set of overdraft or net credit dial wheels, means to rotate said dial wheels to determine the amount of an overdraft or net credit, means to limit the sphere of action of said last-named means, including a rotatably mounted feather carrying shaft, and means for automatically restoring the shaft to normal position.

8. In a machine of the character described, two sets of dial wheels and a set of oscillatory sectors for each set of dial wheels, a sector of each set cooperating with a sector of the other set, said cooperating sectors being connected together for equal simultaneous motion but being adapted for limited relative motion when a transfer is to be made, in combination with means to restore said sectors to proper relative position after the transfer has been made.

9. In a machine of the character described, two sets of dial wheels, and a set of oscillatory sectors for each set of dial wheels, a sector of each set cooperating with a sector of the other set, said cooperating sectors being connected together for equal simultaneous motion but being adapted for limited relative motion when a transfer is to be made, in combination with means to limit the return motion of said sectors, and means to restore to normal position any sector which has been returned beyond that point.

10. In a machine of the character described, over-draft mechanism, transfer mechanism, and locking mechanism connected with the transfer mechanism adapted to be released by the operation of the overdraft mechanism.

11. In a machine of the character described, means for adding or subtracting numbers, means to predetermine the opera-

tion, means to accumulate the total, means to determine the amount of a negative total, means to control the last-named means, and means to lock said control means when actuated whereby completion of the operation of determining the negative total is rendered necessary, in combination with means to lock the means for predetermining the operation and to automatically release the same upon completion of the operation of determining the negative total and to lock the means for determining the negative total.

12. In a machine of the character described, means for adding and subtracting numbers, means to predetermine the operation, means to accumulate the total, means to determine the amount of a negative total, means to control the last-named means, and means to lock said control means when actuated, whereby completion of the operation of determining a negative total is rendered necessary, in combination with means to lock the means for predetermining the operation and to automatically release the same upon completion of the operation of determining the negative total and to lock the means for determining the negative total, said accumulating means being provided with means to control the actuation of the locking means.

13. In a machine of the character described, a set of oscillatory sectors adapted to actuate cooperating dial wheels, a lantern to limit rearward oscillating motion of said sectors and means to oscillate said lantern to rock in a reverse direction any of the sectors which have been released for transferring.

14. In a machine for adding, subtracting, and listing items, mechanism for indicating by a special character any subtracted number which causes the total accumulated by the machine to pass zero, including a hammer, means to hold the hammer inoperative, a set of dial wheels each provided with a tripping finger, the finger of one of the dial wheels being operative to cause the releasing of the hammer holding means, whereby the hammer is permitted to cause the printing of a special character.

15. In a machine for adding and subtracting numbers, mechanism for determining the amount by which the accumulated total has passed zero by reason of one or more subtraction operations, controls for predetermining the operation of finding this amount, locking mechanism for holding one of these controls in actuated position, a latch member for holding the lock in inoperative position, and connections between the latch member and the control whereby actuation of the latter will cause the former to release the lock to lock the control in actuated position.

16. In a machine of the character described, a set of dial wheels, one of said dial wheels having a cam thereon, a rocking lever adapted to engage said cam, a shaft, supporting and connecting means mounted on said shaft for oscillatory motion, arms secured to said last-named means, one of said arms engaging said lever and the other of said arms having secured thereto one end of a link, the remaining end of said link being secured to a pivotally mounted link, operation predetermining controls, locking means for said controls and connecting means between said locking means and said last-named link whereby the rocking of said first-named lever will cause such placing of the parts that actuation of the machine will cause the unlocking of certain controls and the locking of others.

17. In a machine for adding and subtracting numbers, a shaft, friction-drive mechanism secured to said shaft, a sector mounted on said shaft and engaging said friction drive mechanism, another sector loosely mounted on said shaft, locking mechanism holding the sectors in fixed relation to each other, means for unlocking the locking mechanism whereby relative motion of said sectors will be permitted, a U-shaped bail mounted on said shaft and driven by the driving mechanism of the machine, in combination with resilient means connecting the said sectors and adapted to connect the sectors and the U-shaped bail, whereby relative motion of the sectors will be caused when the locking mechanism is unlocked.

18. In a machine for adding and subtracting numbers, a pair of sectors locked together for simultaneous movement, one of said sectors being frictionally driven, mechanism for unlocking the locking means, whereby the sectors may have relative motion, a movable member, and resilient means engaging said sectors and adapted to be engaged by said movable member whereby, when the movable member is actuated, limited relative movement between the movable member and the sectors will be caused.

19. In a machine for adding and subtracting numbers, a pair of sectors locked together for simultaneous movement, one of said sectors being frictionally driven, mechanism for unlocking the locking means, whereby the sectors may have relative motion, a movable member, and resilient means engaging said sectors and adapted to engage said movable member, one of said resilient means causing relative movement between the sectors when they are unlocked and the movable member is actuated.

20. In a machine for adding and subtracting numbers, a pair of sectors locked together for simultaneous movement, one of said sectors being frictionally driven, mechanism for unlocking the locking means,

whereby the sectors may have relative motion, a movable member, and resilient means secured to each sector and adapted to engage said movable member, one of said resilient means adapted to cause relative movement between the sectors when they are unlocked.

21. In a machine for adding and subtracting numbers, a sector driving shaft, friction drive members secured to said shaft, a plurality of sectors mounted on said shaft and driven thereby through the friction drive members, a plurality of sectors loosely mounted on said shaft adjacent said first-named sectors, means to lock said sectors for simultaneous movement in pairs, means to release said locking means so that one sector may oscillate in either direction with respect to its connected sector, a spring on each sector to cause relative movement between the sectors in one direction or the opposite when unlocked, and mechanism to cause the actuation of said sectors.

22. In a machine of the character described, a plurality of banks of keys, a plurality of rotatable correction keys for said banks, an index mark on each correction key, adapted to show whether the key is in normal or rotated position.

23. In a machine of the character described, a plurality of banks of keys, a rotatable correction key for each bank, and an index mark on each correction key to indicate when in normal position that the machine will function normally, but indicating when in rotated position that the part of the machine to the right of the bank in which the rotated key is located will function independently of that bank and those to the left thereof.

24. A correction bar for a key bank in a machine of the character described, comprising a bar provided on one edge with an apertured flange, and having on its opposite edge a pair of lugs lying substantially in the plane of the bar, a third lug bent at an angle to this plane, and a pair of bayonet slots whereby the bar may be easily assembled in the machine and may be reciprocated to retract the stop wires and to release the keys.

25. In a machine of the character described a bank of keys having one key which may function either as part of a splitting mechanism or part of a correction mechanism, the functioning of the key in either respect not affecting its functioning in the other.

26. In a machine of the character described, a key bearing upon its face a numeral indicating the first two figures of the year and adapted, when actuated, to cause the setting of other parts of the mechanism so that the latter, when actuated, shall cause the printing of that part of the year.

27. In a machine of the character described, a key bearing upon its face a numeral indicating the first two figures of the year and adapted, when actuated, to cause the setting of other parts of the mechanism so that the latter, when actuated, shall cause the printing of that part of the year, in combination with other keys adapted to be set to cause the printing of the remaining figures of the year.

28. In a machine of the character described, a bank of keys comprising months of the year, another key adjacent said bank and comprising the first two numerals of the year number.

29. In a machine of the character described, a bank of keys comprising months of the year, another key adjacent said bank and comprising the first two numerals of the year number, a type bar holder provided with type bars corresponding to each of the above named keys, mechanism for causing the type bars to print a character corresponding to any selected one of the above named keys.

30. In a machine of the character described, a dial wheel, a sector for actuating said dial wheel, a series of stops to stop said dial wheel after it has been rotated a predetermined number of spaces, means for predetermining which stop shall be effective in stopping the sector, a zero stop for preventing actuation of the sector to thereby prevent rotation of the dial wheel, means for removing the zero stop to permit rotation of the dial wheel when rotation thereof is desired, and a feather carrying shaft adapted to stop the sector when the dial wheel rotates nine or more spaces.

31. In a machine of the character described, a dial wheel, a sector for actuating said dial wheel, a zero stop for preventing actuation of the sector to thereby prevent rotation of the dial wheel, means for removing the zero stop to permit rotation of the dial wheel when rotation thereof is desired, and a feather carrying shaft adapted to stop the sector when the dial wheel rotates nine or more spaces.

32. A stop mechanism comprising a rotatable shaft, a clutch element secured thereto, a plate carrying a fixed stop having a pivoted clutch element mounted thereon, said plate being loosely mounted on said shaft, a gear connected to said plate, and a pair of stop members adapted to be selectively placed in the path of said pivoted clutch element and said stop on said plate, whereby to disconnect said clutch elements and said stop members.

33. A stop mechanism comprising a rotatable shaft, a clutch element secured thereto, a plate carrying a fixed stop and having a pivoted clutch element mounted thereon, said plate being loosely mounted on said

shaft, a gear connected to said plate, and a pair of stop members adapted to be selectively placed in the path of said pivoted clutch element and said stop on said plate, whereby to disconnect said clutch elements and to stop rotation of said gear by means of one or the other of said stop members, in combination with means to connect said pair of stop members and hold them out of position to engage said stop member on said plate and the connected clutch element, whereby continuous operation of said gear is rendered possible.

34. A stop mechanism comprising a rotatable shaft, a clutch element secured thereto, a plate carrying a fixed stop and having a pivoted clutch element mounted thereon, said plate being loosely mounted on said shaft, a gear connected to said plate and a pair of stop members adapted to be selectively placed in the path of said pivoted clutch element and said stop on said plate, whereby to disconnect said clutch element and to stop rotation of said gear by means of one or the other of said stop members, in combination with means to predetermine and indicate which of the stop members is to be effective in stopping the rotation of the gear.

35. In a machine for adding, subtracting and printing items, means for causing the items to be sorted out and printed in separate columns, said machine having a carriage and an addition-subtraction control, and said means including an automatic release for the carriage whereby the same is permitted to be automatically shifted to right or left upon the actuation of the addition-subtraction control.

36. A manual release mechanism for a stop pawl in a machine of the character described comprising an elongated bale adapted to engage the pawl, a control adapted to be actuated manually and a connection between the control and the bale whereby the latter may be actuated by the actuation of the former.

37. In a stop mechanism, a fixed element carrying an adjustable stop member, a movable element carrying a movable stop member, an elongated pivoted member for moving said movable stop member and a cam member for actuating said pivoted member.

38. A carriage control mechanism comprising a manually actuated member, a lever engaged thereby to be rocked about its pivot, a link reciprocated by said lever, a lever rocked about its pivot by said link, resiliently held levers controlling oppositely rotating clutch members and engaging said last named lever, said clutch controlling levers being adapted upon actuation of said manually actuated means to cause engagement of one or the other clutch member with a member to be driven, whereby said driven member may be rotated in one direction or the other.

39. In a machine of the character described, a pivoted control member, a lever adapted to be rocked thereby, a slidable link connected with said lever, a direction reversing clutch actuated by said link, and a stop mechanism releasing member simultaneously actuated by said link, whereby the member to be actuated may be released for movement and a clutch may be thrown for causing movement thereof in one or the other direction by actuation of a single control member.

40. A carriage release mechanism for a machine of the character described having a longitudinally shiftable carriage, comprising a lever mounted thereon, a link connected to said lever, a pivotally mounted locking pawl, and connections between same and the link whereby the pawl may be released from locking position and the carriage shifted manually upon actuation of the lever.

41. A carriage release mechanism for a machine of the character described having a longitudinally shiftable carriage, a lever mounted thereon, a link connected to said lever, a pivotally mounted locking pawl, and connections between same and the link whereby the pawl may be released from locking position and the carriage shifted manually upon actuation of the lever, in combination with mechanism for actuating the carriage by power driven means.

42. In a carriage mechanism in which the carriage is adapted to be actuated by power driven mechanism, means for locking the carriage in definite locations, and manually operated means for releasing the locking means and shifting the carriage.

43. In a machine of the character described, a frame carrying operative parts, a cover for said frame and parts, a carriage runway casting removably secured to said frame, and a lock secured to the runway casting, having a plunger adapted to enter alined perforations in the cover and frame, whereby to prevent unauthorized removal of the cover and casting from the frame.

44. In a machine of the character described, a support carrying operative parts and provided with a cover for said parts, a second support, external to said cover, connected to said first named support and removable therefrom, said last named support carrying a lock adapted to engage the first named support and cover, whereby to prevent unauthorized removal of said cover and second named support.

In witness whereof, I hereunto subscribe my name to this specification.

MARTIN TEETOR.

sources

sources on internet..png

Some of the internet websites I used to gather information.

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https://www.google.com
https://books.google.com
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Internet Archive
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